

# **WORK, HEALTH AND SAFETY CULTURE/CLIMATE**

**— A STUDY OF EMPLOYEES IN THE NORWEGIAN OIL AND GAS INDUSTRY**

**BY**

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PhD Thesis

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## PREFACE

My work with the thesis has come to an end. It has been an interesting, challenging and long lasting process in combination with full-time work, and I have gained knowledge I would not have imagined some years ago. I would like to take the opportunity to thank all the people who have helped me complete this thesis.

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Oslo, December 2009

Anne Mette Bjerkan

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**SUMMARY**

**Background:** The main focus of this thesis concerns the relationship between health, safety, and (work) environment (HSE) within the Norwegian petroleum industry. HSE was measured by the employees' perception of their health status, the work environment (i.e. the physical and psychosocial) and the work safety climate (e.g. management commitment to safety). This thesis presents three empirical studies concerning the health, safety and (work) environment relationship, and one study concerning the effects of a large-scale safety culture programme.

The theoretical basis for the thesis is the research fields of work and occupational health, and of organisational culture/climate areas, i.e. the safety culture/climate literature. Also, the work presented relies on empirical research conducted within the oil and gas industry, both in Norway and internationally. To some extent the areas of risk perception, occupational accidents and hazards were also examined in greater detail relative to theory in existing empirical work and data drawn from the total group of Norwegian oil and gas employees.

**Aims:** Paper I explored the relationship between employee health perceptions and psychosocial work- and organisation-related factors (e.g. job demands and control) in a sample consisting of onshore and offshore workers employed in a contractor company. Differences between the respective groups (i.e. onshore and offshore), and differences within the groups, based on work group belongingness were also examined.

Paper II studied the relationship between employee perceptions of the work environment (i.e. physical and psychosocial), the work safety climate, risk and health status amongst Norwegian offshore oil and gas employees using data collected by the Norwegian Petroleum Safety Authority (PSA). It was assumed that the employees' perceptions of the work environment, risk and the work safety climate would influence their self-reported health status. It was also expected that employee reporting of subjective health status would influence their reports of limitations in daily work activities offshore. These assumptions were investigated by applying structural equation modelling in two samples collected at two different points in time, i.e. in 2001 and 2003.

Paper III further expanded the examination of the relationship between work, safety, and health perceptions by applying a more complex and specified model, using data collected by the PSA. It investigated how employee perceptions of the physical and psychosocial work

environment and perceptions of the work safety climate, influenced employee health (i.e. ill-health symptoms and general health status) and self-reported involvement in occupational accidents. The model was tested by applying structural equation modelling across eight different work groups employed onboard different operative offshore oil and gas platforms on the Norwegian continental shelf.

Paper IV evaluated the effects of a large-scale safety programme implemented in a Norwegian petroleum company. Five measurement concepts were tested and incorporated into a hypothetical structural model. These were: 1) participation in a two-day kick-off, 2) effectiveness of programme implementation, 3) personal programme commitment, 4) safety behaviour change, and 5) safety culture change. The final model developed in paper IV showed how the levels of personal programme commitment and the effectiveness of programme implementation influenced safety behaviour change and safety culture change.

**Methods:** Papers I through III were based on cross-sectional surveys, while paper IV employed a mixed method approach, including qualitative interviews, fieldwork observations and a questionnaire survey. The data collection in paper I was conducted in the maintenance and modification division of a contractor company (N=414, response rate=47.1%), which has commissions on the Norwegian part of the continental shelf, and also internationally. Paper II used data collected through the “Trends in Risk Level” (TRL) project. The data were collected by the Norwegian Petroleum Safety Authority (PSA) in 2001 (N=3310, approximate response rate=49%) and 2003 (N=8567, approximate response rate=50%). The data used in paper III were also collected through the TRL project in 2005/2006 (N=9945, approximate response rate=50%). In paper IV, data were collected by using interviews (N=151), fieldwork observations and a questionnaire survey (N=1221, response rate=40%) amongst employees in a large operator company and its hired subcontractors.

**Results:** The results in paper I suggested that there were differences between onshore and offshore employees regarding perceptions of work demands, perceived hazards associated with the work tasks and perceived control over work pace. It was shown that offshore workers perceived more risks associated with the work tasks, and perceived less control over the work pace. Differences in health perceptions were identified *within* the onshore and offshore groups, but not between them. There appeared to be a larger variation within the onshore group regarding health perceptions, and in particular in terms of perceptions of their physical

health status. Offshore workers appeared to constitute a more homogenous group of workers with respect to health. Paper I also showed that work- and organisation-related variables accounted for a small amount of the variance in the workers' physical and psychological health complaints.

Paper II showed that offshore employees' perception of the work environment, the work safety climate and risks at work accounted for a small percentage of the variance in their self-reported ill-health symptoms (i.e. 13.9% in 2001 and 11.0% in 2003). A strong relationship was found between subjective health status and the respondent's reporting of limitations in daily work activities offshore. Older employees (over 50 years of age) reported a higher frequency of ill-health symptoms, and also evaluated their general health status more negatively, both in 2001 and 2003. However, older employees in 2001 and 2003 appeared to evaluate their work environment and the work safety climate more positively, and they also perceived less risk at work compared with their younger colleagues.

Paper III showed that there were differences between the work groups regarding perception of HSE-related variables. The physical and the psychosocial work environment along with the work safety climate accounted for different amounts of the variance in health perceptions and self-reported involvement in occupational accidents depending on work group belongingness. Additionally, the results in paper III showed that the correlations between the separate constructs in the composite notion of HSE ranged from moderate to high and were significant. The strongest correlation was found between the employees' perception of the work environment and their evaluations of subjective health status.

The final model developed as a part of paper IV illustrated how personal programme commitment and effectiveness of the programme implementation influenced the employees' reports of safety behaviour and safety culture change. The results in paper IV also showed that participation in the programme's two-day kick-off had both positive and negative effects on personal programme commitment and effectiveness of implementation, due to the high expectations developed among the workers. Furthermore, safety behaviour change influenced safety culture change and vice versa.

**Conclusions:** The results showed that different groups of workers onboard offshore oil installations experience aspects related to health, safety and work environment differently. Furthermore, the physical and the psychosocial work environment and the work safety climate had different impacts on workers employed in different work groups. The results, therefore

suggest that workplace conditions in different occupations affect employee health differently. The implication is that future HSE research should focus on work group characteristics, in order to identify sources of accident and health risks.

Employee age affected the perceptions of health, safety and the work environment. Older employees evaluated their health status more negatively, but they appeared to evaluate their work environment and the work safety climate in a more positive manner. These results imply that there is a need to develop initiatives aimed towards reducing the effect of deteriorated health status due to older age, and to make sure that older employees can utilise their experience and resources more effectively in the context of work.

The respondents that participated in the different studies of this thesis appeared to be healthy and reported few obvious symptoms of ill-health; they also rated their general health status as good or very good. Psychosocial work- and organisation-related variables had a relatively small impact on the employees self-reported health status. Together these results indicate that there is a need to develop new measures to account for employee health and well-being in the work context. This implies that future studies should take into account that health is a multi-dimensional concept, and that a focus on one dimension (i.e. somatic symptoms) is limited, especially among a group of initially healthy employees. Also, including several measures of health (e.g. subjective well-being) may increase the probability of detecting ill-health effects caused by the work environment and the work safety status at an early stage.

The results in the present thesis also suggest that instead of addressing the composite notion of HSE culture/climate, future research would benefit from also focusing on the specific HSE components, i.e. search for dimensions characterising the health culture/climate, the work culture/climate as well as the safety culture/climate.



## LIST OF PAPERS

This thesis is based on the following papers:

### **PAPER I:**

Bjerkan, A.M. (2009). Work and health – A comparison between Norwegian onshore and offshore oil employees. *Submitted*.

### **PAPER II:**

Bjerkan, A.M. (2009). Health, safety and the work environment – A study of employees working in the Norwegian oil and gas industry. *Submitted*.

### **PAPER III:**

Bjerkan, A.M. (2009). Health, environment, safety culture and climate – analysing the relationships to occupational accidents. *In press, Journal of Risk Research*.

### **PAPER IV:**

Olsen, E., Bjerkan, A. M., & Nævestad, T. O. (2009). Modelling the effects of a large-scale safety culture programme: A combined qualitative and quantitative approach. *Journal of Risk Research*, 12, 1-21.

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# 1 INTRODUCTION

In the Norwegian Government's Proposition to the Storting, White Paper No. 12 (2005–2006), it was stated that the Norwegian petroleum sector should be a “pioneering industry” in terms of developing strong, visible and continuing attention towards health, safety, and the environment (HSE). It was further stated that this attention should be visible at every organisational level, and be based on a persistent search for improvement. Implicit in the overall notion of HSE is therefore, a continuing effort to provide the workers with a healthy and safe workplace and to eliminate risks and hazards, thereby focusing on prevention, assessment, and management of health, work environment, and safety issues. In 2002 the notion of a “Health, safety and environment culture” was introduced into Petroleum regulations highlighting the dynamic relationship, and the necessity of, as well as, a close affiliation, between employee health, workplace safety and the work environment (i.e. physical, psychosocial and organisational) in order to achieve further improvement of the HSE standards in the industry as a whole.

This thesis is a part of an overarching project on the “HSE culture” which aimed to identify the common features of HSE, and also to clarify the HSE culture concept, in the Norwegian petroleum industry. Additionally, the HSE culture project is aimed at the development of new models and insights contributing to the formation of a satisfactory culture/climate for health, safety and environment in the entire petroleum sector. The HSE culture project was situated at the Centre for Technology, Innovation and Culture at the University of Oslo, and was funded by the Norwegian Research Council from 2003-2006. In parallel with the HSE culture project the Norwegian Petroleum Directorate instigated a project entitled “Trends in Risk Level – Norwegian Continental Shelf” (TRL) (PSA, 2000). The TRL project's overarching aim was to measure, outline, track, and improve the health, safety, and environmental conditions in the offshore and the onshore petroleum activities and facilities. Another purpose of the TRL project was to track developments and trends in HSE status on the Norwegian Continental Shelf (NCS). So far in the TRL project, four large-scale questionnaire surveys have been conducted, targeted at selected parts of the offshore population. In addition, interviews with key informants in the industry and field observations have been conducted as a part of the TRL project.

The present thesis is based within the HSE culture project, although it also builds on questionnaire data collected through the TRL project. The data were collected by the

Norwegian Petroleum Safety Authority (PSA), and made available to the author to be used as a part of this thesis. Hence, the results presented in the current thesis build primarily on individual-level data collected through different cross-sectional questionnaire surveys conducted at different points in time, i.e. between 2001 and 2005/2006.

### ***1.1 Goal of thesis***

The main focus of this thesis concerns the relationships between health, safety and the environment (HSE) within the Norwegian petroleum industry as measured by the employees' perceptions of their health status, the work environment (i.e. the physical, psychosocial and the organisational) and the work safety climate (e.g. perception of management commitment to safety). Within the occupational health research tradition there has been a long tradition of examining the effect of work-related variables (e.g. job demands and job control) on employee health (e.g. musculoskeletal and psychological complaints) and well-being. Numerous studies have reported that physical, psychosocial and work organisational factors are associated with increased frequencies of ill-health symptoms, sickness absence and reductions in job satisfaction and general well-being. However, relatively few studies have examined these relationships among employees in the Norwegian oil and gas industry. The approach adopted in this thesis is portrayed in Figure 1.1.



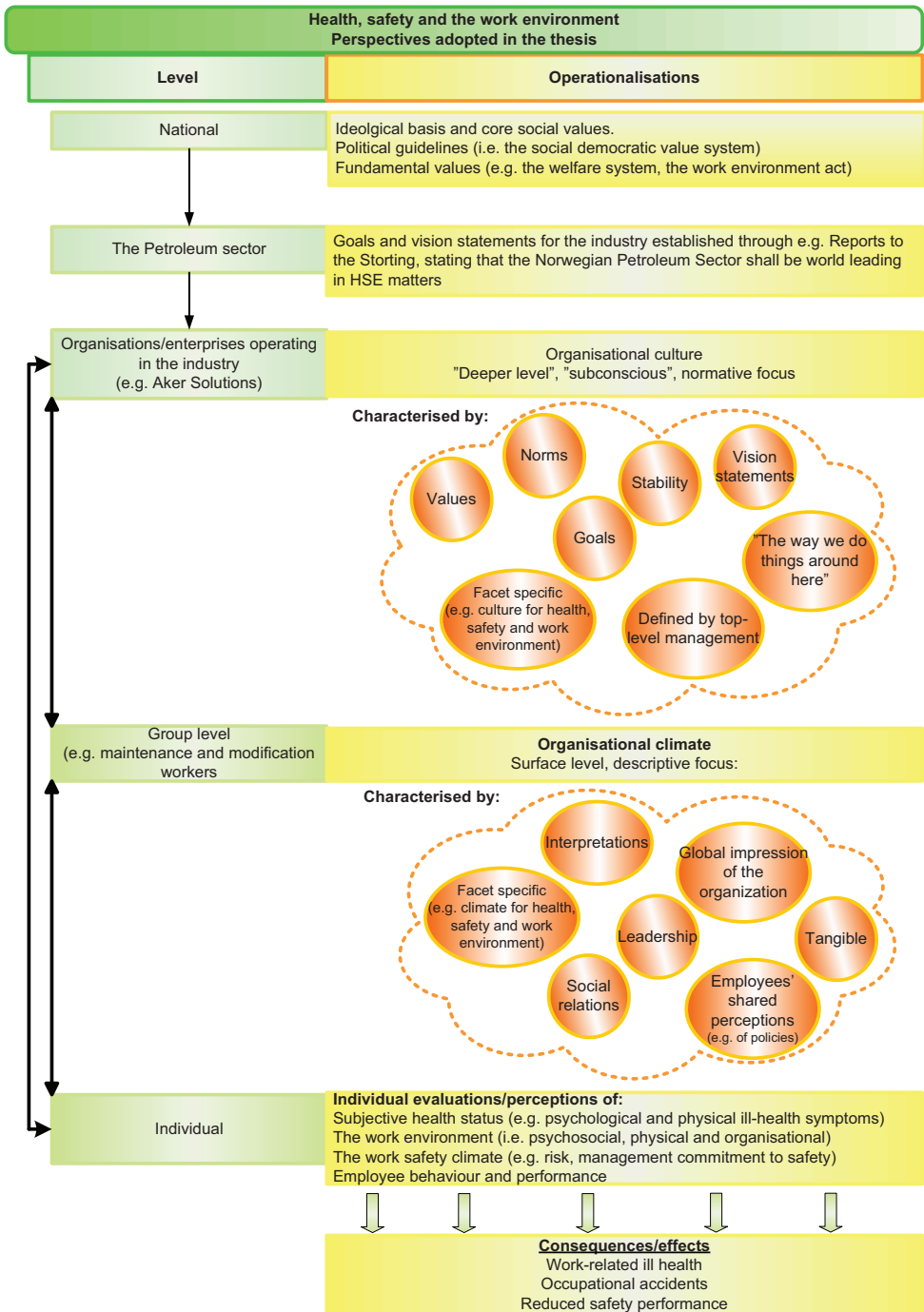


Figure 1.1 Assumed relationships between different levels of culture. An illustration of the different levels of culture and the interactions between different levels.

The original aim of the presented work was to examine whether psychosocial work related factors could contribute to the explanation of employees' subjective health complaints (e.g. musculoskeletal pains and psychological complaints), in a sample of workers in the oil and gas industry. However, the initial results indicated that psychosocial work-related factors accounted for a relatively meagre amount of the variance in subjective health complaints, and thus implied that other work-related factors needed to be included in the analyses to understand better the relationship between work and health amongst oil and gas workers. Hence, the design of the thesis was elaborated to incorporate also the culture and climate dimensions, i.e. perceptions of the workplace safety climate, as well as employee perception of risk. The design was also developed to include different measurements of employees' perceived health status, such as current general health status.

The concept of culture is often referred to in quite vague terms as “embedded” or “internalised” into an organisation. The view adopted in this thesis holds that culture consists of several layers, and that it is the dynamic interactions between these layers that ultimately affects employee health and well-being in the work context. Figure 1.1 suggests that the overall context, or top level, is the national culture (e.g. Norway's political and ideological value system). This top level is the foundation for the views and vision statements implemented in the entire petroleum sector. These views and vision statements will in turn act as guidelines for the individual enterprises operating within the industry, shaping their organisational culture. Hence, the view adopted in this thesis was that organisational- and work-related factors are influenced by external factors and framework conditions, such as the national culture and the economic situation for the society as a whole.

Theoretical and empirical evidence suggest that there is a difference between the culture and climate concepts. Such views are acknowledged in the current thesis. The results reported here are mainly drawn from questionnaire studies directed at samples of individual workers in the industry, and it is therefore more appropriate to frame such results among issues of organisation and work safety climate. This approach also holds that an investigation of organisational and safety culture requires other research techniques (e.g. field studies, observation) compared to what was used in the current work.

The goal of the present thesis is to explore the effects of employee perceptions of work-, and organisation-related variables on employee health and well-being. This goal

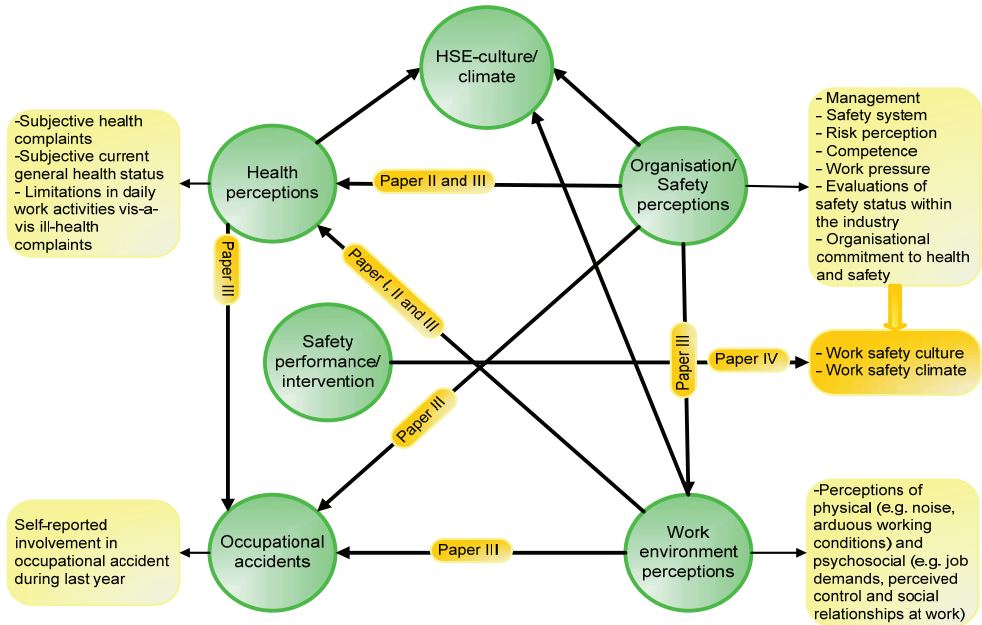
incorporates the culture/climate concept. The presented work specifically examines the associations between health, safety, work environment and employees' self-reported involvement in occupational accidents. Various hypotheses derived from these overarching aims are tested in samples collected through the TRL project and by the author at different points in time, and from different samples of workers in disparate occupational positions, in the Norwegian oil and gas industry.

## ***1.2 Theoretical inspiration for the presented work***

The main theoretical base for the presented empirical work lies within the research fields of work and occupational health and the organisational culture/climate areas, i.e. the safety culture/climate literature. In addition, to some extent, the areas of risk, occupational hazards and occupational accidents were investigated in greater detail relative to theory, existing empirical work and to data drawn from different samples from the total group of employees within the Norwegian petroleum industry. Additionally, the work presented relies on existing empirical research conducted within the offshore oil and gas industry both in Norway and internationally.

In the following, a short historical background will first provide the context in which this thesis was developed. Thereafter follows an account of the central concepts used in the thesis and an overview of existing theories regarding the work and health relationship that inspired the presented work. An overview of the organisational and safety culture/climate concepts that inspired the presented work will also be provided as well as an account of some individual factors/approaches to occupational accidents. Figure 1.2 presents an overview of the central concepts used in the thesis, and illustrates which relationships are considered in the four papers included. As can be seen in Figure 1.2, paper I focuses specifically on the relationship between psychosocial job characteristics and health perceptions among different groups of workers in an onshore and offshore work environment. Paper II attends again to this relationship and also includes the safety aspect in two samples of offshore workers collected at two different points in time (i.e. in 2001 and 2003). Paper III deals with all three HSE concepts and also includes occupational accidents into the design, which uses structural equation modelling to investigate these relationships in different occupational groups in the offshore environment. Paper IV deals with safety behaviour and safety culture change and examines the effect of a large scale safety programme adopted in a large Norwegian based petroleum enterprise. The empirical materials and details of the three papers are explained in the methods part of this thesis,

following the introduction. A summary of the main results then follows. The last part of this introductory part of the thesis discusses the results and attempts to place them in a wider theoretical, empirical and practical context. The last part also discusses the composition and parts of the HSE concept relative to the results of the presented work and places the HSE concept in a wider context.



*Figure 1.2 Conceptual model portraying the central concepts and the associations examined in the individual papers included in the thesis.*

The arrows in Figure 1.2 present the assumed relationships between the included variables in this thesis. The employees' perceptions of self-reported health status, and self-reported involvement in occupational accidents were treated as individual level outcome variables. Employee perceptions of the work safety climate and the work environment were treated as work- and organisational related variables, exerting an effect both on employee health perceptions and self-reported involvement in occupational accidents.

### ***1.3 Historical background, especially focused on the times of the data collection in the thesis work***

#### **1.3.1 The beginning**

The Norwegian oil adventure started in the fall of 1962. The Norwegian government was contacted by Phillips Petroleum, an American oil company, which wanted to conduct drilling operations off the Norwegian coast. That same year, large international oil companies like Esso and Shell also voiced their interest in conducting drilling operations on the Norwegian part of the continental shelf. In the following years, several oil companies conducted exploration drilling operations on the NCS, but none of them found oil/gas fields that were commercially profitable. By the end of the 1960s most of the companies considered giving up the search for oil on the NCS. Phillips Petroleum Company had, however, rented a drilling rig – the Ocean Viking – for which they had to pay a fixed period rent, so they decided to try one more time. They started their drilling operations on the 21<sup>st</sup> of August 1969, and a few days later, the Ekofisk field was discovered. By June 1970 it was made public that a gigantic oil discovery had been made on the NCS, ultimately changing Norwegian history.

Presently there are 60 oil and gas fields in production on the NCS (Ministry of Petroleum and Energy, 2009). In 2007, Norway was ranked as the worlds fifth largest oil exporter, the eleventh largest oil producer and the third largest gas exporter in the world (Ministry of Petroleum and Energy, 2009). It is expected that a high level of production will be maintained in the years to come. Only one per cent of the world's oil reserves are estimated to be located within Norwegian territory, and the reason for Norway being a large exporter of oil can be found in the fact that it exports 90 per cent of its oil production. The situation is similar with regard to gas production. Norway has three per cent of the world's gas reserves.

The petroleum industry is the largest industry in Norway, accounting for approximately 20 per cent of Norway's gross national product and for 26 per cent of Norway's national value creation (Ministry of Petroleum and Energy, 2009). At present, approximately 200 000 people are employed in petroleum related activities, including contractor employees and employees onshore. These facts illustrate the importance of the oil and gas industry in Norway, as well as in an international context and consequently underlines that HSE improvements in the sector could contribute to improvements also in a global context.

### **1.3.2 "Origins" of health, safety and environment (HSE) in the Norwegian offshore oil industry**

The first drilling rigs on the Norwegian part of the continental shelf were American, as were the employees and the equipment. Haukelid (1998) has denoted this first era of oil production as "Texas" (Haukelid, 1998). The "Texas" era was characterised by a rough working environment, a frenetic work pace, a high degree of risk and numerous accidents (Haukelid, 2008; Haukelid, 1998). Many employees also lost their lives in helicopter accidents during this early period of oil production. For many Norwegians the first encounter with American corporate culture was a shock, and the American bosses showed little regard for the "basic social democratic rights" to which the Norwegians were accustomed (Haukelid, 2006). During the time period from 1966 up until 1978, when most of the activity on the shelf was concentrated around three fields, 18 employees died in occupational accidents while offshore (Ryggvik, 2003).

The early era of oil production on the NCS ended with a tragedy in March 1980 with the Alexander L. Kielland accident. The accommodation platform (i.e. a platform that contains bedrooms, lounges, kitchens and leisure facilities for workers) capsized on the Ekofisk field. Of the 212 workers, 123 onboard the installation lost their lives (Ryggvik & Solbakken, 1997). The accident shocked not only the industry, but also Norwegian society at large. As a result of this accident, the Norwegian government passed regulations to improve the working conditions and the work environment in the industry. The plan to "Norwegianise" the industry involved new demands for training, education and safety courses, and introduced a new requirement that made the presence of Norwegian management obligatory onboard the installations (Haukelid, 1998). The Norwegian government wanted to establish a Norwegian area of expertise in the oil and gas industry, and to make foreign operator companies more adapted to the Norwegian working life. During the period from 1980 to 1990 the internal control reform was implemented along with other safety measures, which resulted in substantial drop in accidents in the industry (Ryggvik, 2003; Haukelid, 2008).

By the end of the 1980s comprehensive safety management systems were introduced by the oil companies. Technological improvements were also introduced, which helped protect the workers from dangerous work operations. These safety systems, along with corresponding theoretical accounts, such as the "Iceberg theory" and the "Loss Causation

Model”, gave structure and direction to the applied safety measures (Haukelid, 2006). However, the introduction of new systems to manage safety in the industry also involved more bureaucracy and little actual reduction of Lost Time accidents, i.e. a measure of the number of incidents at work that resulted in one or more days sick leave (Haukelid, 2006).

Haukelid (2008), states that the oil industry had become complacent by the end of the 1990s, assuming that the safety systems that were introduced during the 1990s themselves would ensure the safety and health of the personnel working offshore. The trade unions however, were claiming that safety matters on the shelf were at an all time low at the end of the 1990s, and that the risk level in the industry was increasing. Their view was confirmed by the Petroleum Safety Authority (PSA), and also by independent research communities, i.e. they agreed that the level of risk within the industry was increasing (Haukelid, 2008). The observation was, among other factors, based on an increase in the number of serious incidents causing injuries to personnel, and also on the recorded increase of oil and gas leakages. Additionally an increase in the number of collisions between supply ships and platforms were observed during this period (Haukelid, 2006; Haukelid, 2008; Hovden, 2004). Furthermore, a (temporary) fall of the oil prices in 1998, and increased international competition, contributed to cost reducing strategies among all of the companies operating on the NCS. Such measures in turn affected how the companies in the industry dealt with matters related to HSE. Additionally, the industry had witnessed major technological, operational and organisational changes, often without the corresponding focus on health, safety and the environment (Morken, 2004). It was also argued that the excessive changes that occurred within the petroleum industry had contributed to reduced job satisfaction and a loss of relevant competence in several important areas, particularly due to the extensive downsizing that occurred during the late 1990s.

As a result of these negative developments, the PSA introduced several measures, one of which was a regulation enforcing HSE culture/climate in the industry. The Framework regulation stated that:

The party responsible shall encourage and promote a sound health, environment and safety culture comprising all activity areas, and which contributes to achieving that everyone who takes part in petroleum activities takes on responsibility in relation to health, environment and safety, including

also systematic development and improvement of health, environment and safety

(The Framework Regulation, Chapter 3, Section 11)

Along with this regulation, the “Safety Forum” and “Working Together for Safety”<sup>1</sup> were implemented. “Working Together for Safety” was established in 2000 as a project trying to remedy the situation of mistrust and scepticism between the employer and the labour organisations regarding safety in the industry. It is cited as the Norwegian oil industry’s most comprehensive project implemented in the field of health, safety and environment. The “Safety Forum” was established in 2001 and is described as the most central arena for cooperation between the industry and the authorities, regarding HSE issues.

The period from 1992 until today has been characterised by continuous efforts to maintain the industry’s position both nationally and internationally, and by increased exploitation of already existing fields on the shelf. Some of these fields are today considered mature, a position that has inspired the oil and gas companies to develop new strategies and new technology to extend the production. This development is also known as the increased oil recovery (IOR) programme and is a part of the “Petromax” programme, funded by the Norwegian Research Council.

At present, therefore, the Norwegian oil and gas industry has evolved from a phase where industrial development was the most important task, to a phase where administration of the revenues from the industry constitute the major task (Ministry of Petroleum and Energy, 2002). It is estimated that only 36 per cent of the resources on the Norwegian shelf are extracted, produced and sold (Ministry of Petroleum and Energy, 2009). This estimate indicates that the sector will continue to hold a significant position in Norway’s economy and welfare system in many years to come. Furthermore, the Norwegian government has explicitly recognised that the oil and gas industry shall function as a “pioneering industry” for *all* onshore based industries, such as the construction industry, through, for example quality HSE work. In the White Paper No. 12 (2005-2006) (Ministry of Labour and Social Inclusion, 2006) it is recognised that today’s petroleum activities generally hold a high level of HSE standards. The White Paper assumes that adequate work with HSE, not only will increase the sense of security for the individual worker, but also is a central premise

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<sup>1</sup> The participants in the working together for safety cooperative project include oil companies and supplier companies represented by the Norwegian Oil Industry Association (OLF), Lederne, the Norwegian Oil and Petrochemical Workers’ Union (NOPEF), LO-Industri, and the Norwegian Shipowners’ Association. The Norwegian Petroleum Directorate has participated in the project as an observer.



for petroleum operations conducted in new territories, delivery security and internationalisation. Furthermore, quality work with HSE will improve the reputation for the companies operating in the industry, and also give them a competitive advantage in terms of being able to recruit skilled workers. However, it is also underlined in the White Paper that potential accidents in the industry are associated with catastrophic consequences, both in terms of human tragedy and enormous economical costs.

### **1.3.3 Laws and regulations governing the petroleum sector**

The legal framework for the petroleum sector (§ 11) states that each company operating on the Norwegian shelf shall promote and encourage a *satisfactory* culture for health, safety and environment. It also expresses that the responsible party must be committed to a continuous effort to improve and develop the level of HSE standards within the industry (Rammeforskriften, 2001). However, the regulations do not specifically define what this HSE culture concept should entail, and thus allows for different interpretations of its meaning and content. The official understanding of the PSA concerning the overarching HSE concept is based on several laws and regulations. In the HSE area, the Norwegian Pollution Control Authority, the Norwegian Social and Health Directorate and the PSA cooperate on the total regulations relating to health, safety and environment. Hence, the HSE regulations are issued in pursuance of the Petroleum Act (Ministry of Petroleum and Energy, 1997), the Pollution Act (Ministry of the Environment, 2007), the Product Control Act (Ministry of the Environment, 2006), the Health Personnel Act (Ministry of Health and Care Services, 2009), The Patients' Rights Act (Ministry of Health and Care Services, 2008), The Communicable Diseases Control Act (Ministry of Health and Care Services, 2006), the Work Environment Act (Ministry of Labour and Social Inclusion, 2009) and Health Related and Social Preparedness Act (Ministry of Health and Care Services, 2005). These laws constitute the basis for the petroleum sector's framework regulations (Royal Decree), the management regulations, the information duty regulations, the facilities regulations and the activities regulations.

### **1.3.4 Trends in risk level – Norwegian continental shelf**

As a response to the increased level of risk within the petroleum industry in the late 1990s, the Norwegian Petroleum Directorate (NPD) introduced a project entitled “Trends in Risk Level – Norwegian Continental Shelf” (TRL) (PSA, 2000). In 2004 the PSA took over the main responsibility for the TRL project. The main objectives of the TRL project were to develop and apply measuring tools that could outline and track the trends in the risk level

on the NCS. The project also aimed at documenting the effects of the safety work within the industry, and at identifying risk areas related to the work environment, health and safety. The results from the pilot project (1999/2000) showed that the overall risk trend associated with large scale accidents/catastrophes had decreased between 1980 and 2000. Nevertheless, it was noted that the risk of experiencing work accidents leading to injury, near-misses and gas leakages had increased during the time period between 1997 to 2000 (PSA, 2000).

### **1.3.5 Summary**

To summarise, much attention has been directed at HSE work and improvement. Nevertheless, the general perception is that *safety* plays a central role in the TRL project and also generally within the industry. Much of the work has been focused on the reduction of objective risks and hazards in the work environment, as well as controlling the technical aspects of engineering, construction and operation of the oil and gas installation. Psychosocial work environment conditions and health related aspects have been scarcely covered in the Norwegian oil and gas industry. Therefore, and in light of the fact that the PSA highlights the *dynamic interaction* between health, safety and environment as a prerequisite for a positive, sound HSE culture/climate, it is considered important in this thesis to direct more attention towards the health and work environment aspects of the composite HSE concept. The following parts of the introductory chapter will therefore outline the areas of work and health, as well as the interaction between these concepts in the oil and gas industry.

## **1.4 Work**

Work has a central and valued position in a person's life, and the work role contributes significantly to an individual's identity, meaning and satisfaction in life (Brown et al., 2001; Svensson, Müssner, & Alexanderson, 2006). This is, for instance, demonstrated by the amount of time people commit to work and by the economic consequences of work for individuals, organisations and for the society at large. A person being part of the workforce is being offered opportunities of performing and contributing, of being rewarded and esteemed, and of belonging to a significant social group (Tsutsumi & Kawakami, 2004). Work also plays an important role for employee health and well-being, for instance, as a result of well-functioning social relations in the workplace (Arwedson, Roos, & Björklund, 2007; Polyanyi & Tompa, 2004). In contrast, however, problems related to the work environment (e.g. stress, heavy workload, long work hours and poor social relations in the

workplace) have been consistently related to reduced physical and psychological health among employees. Nevertheless, research generally indicates that working is more health promoting when compared with the option of unemployment. Due to these reasons, the workplace is increasingly seen as a central area for health promotion efforts. Furthermore, it has become apparent that it is necessary to assess a variety of physical, chemical, organisational and social factors in order to get a full description of the work situation and the resulting effect on employee health and well-being (Savinainen, Nygård, & Ilmarinen, 2004). The Norwegian work environment act specifies that Norwegian workers must not only be protected from chemical and physical hazards in the workplace, but that the work must also promote workers' health by means of high levels of decision authority and opportunities for personal development and professional training (Ministry of Labour and Social Inclusion, 2009; Torp & Groggaard, 2009).

Working life and work environments have changed dramatically during the last few decades. Included among these changes are factors, such as increased globalisation, an ageing workforce and changes in employment conditions (e.g. more part time employees) (Sparks, Farragher, & Cooper, 2001). Furthermore, there has been a marked expansion of service work and a reduction in traditional industrial work. Therefore, the working conditions which threaten employee health are different from those that were in place a couple of decades ago. Additionally, fewer jobs are today defined by physical demands, whereas mental and emotional demands have become increasingly important and highlighted (Siegrist et al., 2004). It has been suggested that a major shift in "health stresses" has occurred in the work area, advancing from the "age of muscles" to the "age of nerves" (Hiel, Kentner, Kohler, Mattik, & Schack, 2000), indicating a growing significance of psychosocial and mental work demands in today's workplaces. The physical stress factors are becoming more controlled and manageable, for instance with regard to fixed threshold values of exposure, and by the means of more automated and modern production methods. However, the exposure to psychosocial and emotional stress factors are increasing, and have, according to some authors, had a detrimental effect on the health of the workforce (Landsbergis, 2003). Psychosocial and emotional stress factors in the workplace also require more flexible and innovative solutions, most often without the existence of fixed threshold values.

The specific workplace environment includes the physical, psychosocial and organisational characteristics (Chan & Huak, 2004; Garcia, Boix, & Canosa, 2004). Workplace factors

(e.g. job-related factors, the individual work section and format) can be categorised as those related to the content of work and those related to the social aspects and organisation of work (Michie, 2002; Peterson, 2004). Also included are external factors that influence the job (e.g. the national economy, national culture and framework conditions), characteristics associated with the individual worker (e.g. personality dispositions, competence, motives, etc) and the available technology used in work operations. A balance should be upheld between these elements. A satisfactory level of such a balance (i.e. between physical, psychosocial, organisational and ergonomic working conditions) has been related to reductions in experienced stress and decreases in negative health consequences. For instance, early research showed that physical and psychosocial features of an adverse work environment directly affected workers with injuries and cardiovascular diseases (House & Smith, 1985).

The physical environment comprises the full spectrum of biological, physical and chemical entities, whether natural or manmade (Morris, Beck, Hanlon, & Robertson, 2006). Physical work environment conditions include factors, such as environmental surroundings (e.g. noise, lightning conditions and temperature), workload and postures (e.g. heavy lifting, uncomfortable work positions), work schedules (day/night work) and a high physical work load (Carlopio, 1996). These factors have been shown to exert a detrimental effect on employee health and well-being in the workplace if they are not responded to, and if they are sustained over a prolonged period of time. Research has shown that physical work environment factors, such as the above-mentioned, are related to an increased rate of sickness absence (Hoogendoorn et al., 2002; Voss, Floderus, & Diderichsen, 2001), musculoskeletal pains (Bauer, Huber, Jenny, Muller, & Hammig, 2009; Parkes, 1999; Shannon, Mayr, & Haines, 1997), fatigue (de Croon, Blonk, de Zwart, Frings-Dresen, & Broersen, 2002), stress (Cartwright & Cooper, 1997), reduced self-rated health (Bauer et al., 2009), and an increased risk of accidents and injuries in the workplace (Benavides, 2006).

Social and psychological experiences in the workplace are usually subsumed under the heading of the psychosocial work environment (Hammer, Saksvik, Nytrø, Torvatn, & Bayazit, 2004). The most commonly used definition of the psychosocial work environment highlights the employee's perception of job demands, perceived control and the experience of social support within the context of work (Karasek & Theorell, 1990). However, a broader description of the psychosocial work environment includes the perception of the

social and psychological characteristics of the work tasks, and the general environment in which work is carried out; and these factors may be important in the causation of work-related illness (Hemingway & Marmot, 1999; Parkes, Farmer, & Carnell, 2004). These social and psychological characteristics are assumed to carry unique connotations for each individual worker within the work environment (Baker, Jacobs, & Tickle-Degen, 2003; Stansfeld & Candy, 2006; Skogstad, 2000). The psychosocial work environment are characterised by the interplay of two levels, namely the individual (i.e. personal dispositions relative to the work environment) and the structural elements at the group or organisational level, e.g. the specific working conditions as experienced by the individual worker (Hoogendoorn, van Poppel, Bongers, Koes, & Bouter, 2000; Singh-Manoux, Macleod, & Smith, 2003). Psychosocial work environment factors are thought to influence employee health and well-being. Factors, such as perceptions of high demands, low control, low social support and a discrepancy between efforts spent at work and rewards gained from work, have, in several studies, been related to ill-health effects, such as increased rates of sickness absence, cardiovascular diseases, musculoskeletal pains and psychiatric disorders (Bongers, de Winter, Kompier, & Hildebrandt, 1993; Davis & Heaney, 2000; deJonge, Bosma, Peter, & Siegrist, 2000a; Head et al., 2007; Houtman, Bongers, Smulders, & Kompier, 1994; Kivimaki et al., 2002; Peter & Siegrist, 1999; Schnall, Landsbergis, & Baker, 1994).

Organisational factors are related to the company policies and systems, design, management and the organisation of work, as well as to the technical and social arrangements of the workplace (Gimeno, Amick, Barrientos-Gutierrez, & Mangione, 2009; Gordon, 1998). Included are, for example, management commitment and involvement in safety efforts in the workplace. Research has indicated that management practices play an important role in promoting organisational effectiveness, as well as employee health and well-being (Lim & Murphy, 1999). Additionally, research has indicated that employees' perceptions of organisational factors are important for safety as well as for the workers' job satisfaction, behaviour and self-reported health status (Argyris & Scön, 1978; Karasek et al., 1990; Shannon, Robson, & Sale, 2001).

Physical, psychosocial and organisational factors are likely to interact in the workplace (Carayon & Smith, 2000; Lund, Labriola, Christensen, Bultmann, & Villadsen, 2006). The implication is that the effects of the work environment on specific outcome measures, such as employee health and involvement in occupational accidents, are due to a set of complex

interactions between psychosocial, physical and organisational factors and processes within the context of work (Amick & Kasl, 2000). Efforts to improve the work environment must therefore, take the entire organisational system into account to estimate correctly the context and its resulting effect on employee health and well-being. Efforts aimed at improving the physical work environment may also prove to have added value if they simultaneously involve psychosocial workplace factors, as well as the organisational structure of the work environment (Melchior, Niedhammer, Berkman, & Goldberg, 2002).

The offshore work environment differs from most work environments situated onshore, due partly to the remote and geographically isolated location of most offshore oil installations. A large part of the data materials of the current thesis involve offshore oil employees, and one of the objectives was to examine aspects related to health and the work environment within the oil and gas industry more thoroughly. A description of the offshore working environment and its associated effects on the employees working there is presented in section 1.4.1.

#### **1.4.1 The offshore working environment**

In 1987, Cox and Norman described the offshore working environment as a “rough and tough world” (p. 97), implying that working offshore is stressful and that good mental and physical health of the workforce is a necessity (Chen, Wong, Yu, Lin, & Cooper, 2003; Cooper & Sutherland, 1987; Cox & Norman, 1987; Parkes, 1999). The offshore work environment has changed during the last years, due to factors, such as organisational restructuring, downsizing, technological innovations and an increased safety focus in the industry. All these changes have had impacts on the offshore employees. In some cases, the work has become more automated and decreased the physical demands associated with working offshore, while introducing new challenges in terms of handling new and advanced technological equipment, and thus increasing the strain on the employee’s information processing system.

The term *stressor* refers to a situation, event or demand, which disrupts a person’s equilibrium and triggers a stress reaction. Hence, a *work stressor* is defined as one that is located within, or arises from, the organisational, physical or psychosocial work environment and that has the potential to decrease the health and well-being of the workers (Hurrell, Nelson, & Simmons, 1998; Li, Chen, Wu, & Sung, 2001) . Stressors in the offshore work environment include virtually every health hazard common to land based

industry, such as the mining or the construction industry. In the offshore work environment, there are chemical hazards (e.g. toxic substances), physical hazards (e.g. noise, vibrations), ergonomic hazards (e.g. the design of the work station) and psychosocial hazards associated with the work itself (e.g. social relations at work). There are also stressors associated with the location (e.g. working at sea, remoteness and isolation), and dangers associated with the drilling operations and the helicopter transportation to and from work (Chen, Yu, & Wong, 2005; Mearns & Flin, 1996). All these stressors, or work inherent sources of stress, can contribute to increased psychological stress reactions among offshore oil personnel (Gardner, 2003).

Previous research recognises that work within the offshore oil industry is both physically and mentally demanding for the workers (Mearns & Hope, 2005). Furthermore, working at sea on an offshore installation has been depicted as dangerous and socially isolating where the work tasks involve a high workload and a high degree of stress (Cooper et al., 1987; Parkes, 1998). Work onboard offshore oil and gas installations are characterised by around-the-clock activity, and the employees work 12-hour shifts followed by 12-hours of restitution. Consequently, while onboard the installation, the workers usually work 84 hours a week, and this contrasts with the 40-hour week more usually found in onshore-based industries, where the workers commute home after each shift. In addition to the 84 hours of work per week, overtime and 16-hour work shifts are common, according to the Petroleum Safety Authority (PSA, 2006). In the Norwegian oil and gas industry, the workers are usually offshore for a period of 14 days, followed by an off period, typically lasting four weeks. Generally speaking, the wage costs are higher and the working times are lower on the NCS as compared to other international continental sectors. For instance, on installations in the United Kingdom (UK) North Sea sector, the most common shift pattern is two weeks offshore, alternating with two weeks of rest onshore (Parkes, 2007). Working offshore is also characterised by a high degree of structure and regulation with a strict safety regime in order to avoid dangerous tendencies or accidents that could potentially have catastrophic consequences for the individuals working there and for the society as a whole (Parkes, Carnell, & Farmer, 2005).

Early research has highlighted noise as a particular problem in the offshore work environment (Sunde, 1983). More recent research has indicated that the perceived physical work environment stressors (e.g. bad weather conditions, poor lighting conditions, noise) are partly dependent on *job type*. Parkes and Clark (1997), for instance, found that the

offshore job type predicted exposure to physical stressors. Their results indicated that drilling and construction personnel reported the highest level of exposure while catering and office-based personnel reported the lowest level of exposure (Parkes & Clark, 1997a). Similarly, Parkes and Byron (2001), in their study including employees in five different operating companies (N=909) on the United Kingdom Continental Shelf (UKCS), found that different job groups reported significantly different levels of exposure to physical environment stressors (Parkes & Byron, 2001). Exposure to physical stressors in the offshore work environment also seems to vary with type of installation. For instance, Parkes, Farmer and Carnell (2004) analysed data from 470 male personnel employed on seven installations (six FPSO's<sup>2</sup> and one fixed platform) on the UK continental shelf. Their results showed that the installations differed significantly on measures of the physical work environment (Parkes et al., 2004). The physical work environment was measured both in terms of general environmental stressors (e.g. poor workplace design, vibration/movements, cold/bad weather, poor ventilation) and specific environmental stressors (e.g. heavy physical workload, working in heights). Their results showed that differences between job groups seemed to be larger than differences between the installations (Parkes et al., 2004). Research has also demonstrated a link between employees' perception of the physical work load, perceived stress and the perceived hazardousness of the work environment and the experience of occupational accidents and injuries (Rundmo, Hestad, & Ulleberg, 1998). These authors argue that perceptions of stress, work load and risk may impair the personnel's ability to avoid risk and thereby make them more prone towards experiencing accidents, injuries and near-misses at work.

Psychosocial stressors in the offshore work environment include the remote and isolated location of many offshore oil and gas installations, the confined living and working conditions, time pressures and an excessive work load, combined with periods of boredom, low activity and monotonous work (Chen et al., 2003; Parkes, 1994; Parkes, 1998). These stressors have, in previous studies, been considered to be significant sources of psychological stress amongst offshore oil personnel. Also characteristics of the installation, such as age, location, size and type have been linked to employee well-being and job satisfaction (Parkes, 2002). It has been reported that psychosocial factors are important for the prediction of both feelings of safety and of accident involvement among personnel

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<sup>2</sup> Floating Production Storage and Offloading Vessel is a type of boat/vessel or floating tank system used by the offshore oil and gas industry and designed to take all of the oil and gas produced from its own and nearby installations and process it until the oil and gas can be offloaded onto a tanker or transported through a pipeline.



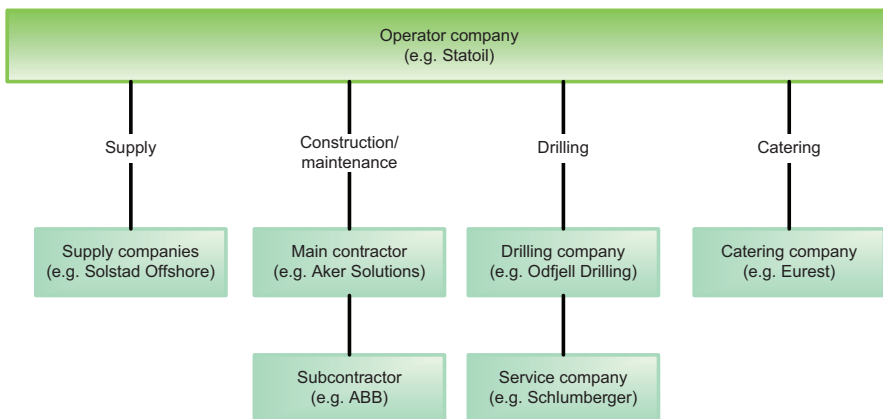
onboard offshore oil and gas installations (Mearns, Rundmo, Gordon, & Fleming, 2004). Moreover, research indicates that these factors also contribute to an increased frequency of musculoskeletal health complaints, such as upper extremity disorders (Carayon, Smith, & Haims, 1999; Chen et al., 2005). However, it is also important to mention the positive factors that are seen to be related to working in the offshore oil and gas industry. These include, for instance, favourable pay rates, long periods of leave and careful monitoring of individual health status. These are factors are assumed to have a positive effect on employee health and well-being at work.

### **1.4.2 Work conducted onboard Norwegian offshore oil installations**

An offshore platform is a large structure used to house workers and machinery needed to drill wells on the ocean bed, extract oil and/or natural gas, process the extracted fluids and ship or pipe them to shore. There are several distinct types of platforms and rigs, such as fixed production platforms and movable floaters, like semi submersible platforms and production ships (e.g. FPSOs). These installations vary considerably in size, design, location and type. The fixed platforms are built on concrete and/or steel legs anchored directly onto the seabed, supporting a deck with space for drilling rigs, production facilities and crew quarters, and such platforms are designed for very long term use, normally in the same location. These characteristics mean that the platforms will behave differently under bad weather conditions. For instance, a semi-submersible platform might move more than a fixed platform in high waves, and they can also, more easily, come adrift accidentally during storms, which may induce more stress on the personnel onboard. For increased safety, larger platforms are assisted by smaller ESVs (Emergency Support Vessels) that are summoned when something goes wrong, e.g. when a search and rescue operation is required. During normal operations platform supply vessels (PSVs) keep the platforms provided with supplies and provisions.

The different tasks performed on the platform can be subsumed under two broad categories of employees, i.e. those in an operator company and those in a contractor company. The operator company has the overarching authority and responsibility for the oilfield's lifespan (i.e. every operation from front-end field studies, drilling, field development, operation and dismantling). The operator hires different contractors to do the different tasks (Hovden, Lie, Karlsen, & Alteren, 2008). Contractors will in turn outsource parts of the tasks to sub-contractors. The operator company also generally provides the key personnel on the platform, such as the OIM (offshore installation manager), supervisors

and control room personnel (O'Connor & Flin, 2003). Numerous operations are put out to tender, and these tasks are conducted by employees in a contractor company, such as construction, supply, catering, maintenance, drilling, etc. (Hovden et al., 2008). Contracts can vary in length and size, and may imply that a large part of the workforce experience a lack of stable employment and permanence in the workplace since the contractor employees perform tasks onboard various installations that are operative on the shelf, and hence do not work for the company that actually operates the platform. Research has indicated that contractor staff often feel less safe and more isolated than operator workers and that these workers often report more strain as a consequence of being in an organisation that is not their own (Mearns & Flin, 1995). Presently, it is estimated that approximately 70 per cent of the employees working on the Norwegian continental shelf are hired through contractor companies, while approximately 30 percent of the staff onboard an installation consists of employees hired through an operator company. Figure 1.3 provides an overview of the main work groups onboard an offshore oil installation (adapted from Ryggvik & Solbakken, 1997).



*Figure 1.3 Different work areas and work tasks conducted within the context of an offshore oil installation, examples of hired staff from other companies are included in the figure (source Ryggvik & Solbakken, 1997).*

The exposure rate to physical stressors varies across types of installations, but not necessarily across different operational companies. For instance, studies have shown that the type of installation exerts more influence on the workforce's perception of psychosocial and organisational factors associated with safety, than the national culture of the company operating the installation (Mearns et al., 2004). Furthermore, with regard to contractor employees, research has shown that employees working within one specific

contractor company report greater exposure to physical environmental stressors than employees in the company operating the installation (Parkes et al., 2004). Contractor employees also have an increased risk of occupational accidents, and are often considered to be in more of an economic “squeeze” and constantly under pressure to do their job within the agreed budgets, as compared to the operator company employees (Hovden et al., 2008; PSA, 2008).

### **1.4.3 Differences between the work groups**

Previous research has shown that the employees who have the heaviest physical work under the most adverse environmental conditions include the drilling personnel. Parkes & Swash (2000), for instance, showed that drillers accounted for 17.6 per cent of fatal and serious accidents and injuries, and that this figure was higher than for any other work group, such as construction work, deck work and maintenance work (Parkes & Swash, 2000). Drilling operations are conducted onboard fixed, semi-submersible platforms or onboard drilling vessels, and represent the starting point for all activity on the NCS. Employees in drilling and well service are usually employed through contractors within the offshore hierarchy. Their work was previously associated with a heavy physical work load. During recent years, however, more and more of their operations have become automated and hence, require less physical strength of the individual worker. On the other hand, the technology associated with drilling operations offshore has become more complex and therefore, requires more attention and knowledge from the workers. Additionally, much of work involved in drilling and well-services involves that workers generally spend a limited amount of time onboard specific installations – a factor that could contribute to the frequency of accidents in this group, because the installations vary in layout, accessible equipment and work procedures. Evidence also indicates that the different job types and tasks vary in work demands, perceived control and with respect to where in the organisation or in what context they are located. The general idea is that workplace conditions in different occupations affect the employees differently and that such differences ultimately affect employee health (Marklund, Bolin, & Von Essen, 2008). Thus different work types offshore have different status in the offshore hierarchy; they are associated with different sources of risks and hazards, and there are different physical demands associated with the work operations.

In Parkes and colleagues’ (2004) survey among employees on seven installations (six of which were FPSOs and one that was fixed), one of their objectives was to measure the

psychosocial work environment (Parkes et al., 2004). They used four measures of job characteristics, i.e. workload, task variety/skill utilisation, autonomy and clarity and two measures of social support, i.e. support from superiors and support from co-workers. Their results showed differences between the job types and the included psychosocial measures. Management jobs were rated relatively high and positively on all the characteristics, whereas maintenance personnel tended to rate their psychosocial work environment in a less favourable manner. The catering personnel that participated in their study reported a high workload combined with low levels of task/skill variation (e.g. varied activities, opportunities to learn and interesting work). The measures used to describe the psychosocial work environment in Parkes and colleagues' (2004) study also varied across different types of installations.

#### **1.4.4 The workforce on Norwegian offshore oil installations**

The majority of the workers on the NCS are male, and between the ages of 30 to 50 years old (approximately 60 per cent in 2007). The number of employees over the age of 50 has increased during the last few years, according to results from the TRL project, from 19.7 per cent of the workforce in 2001 to 24.3 per cent of the workforce in 2007 (PSA, 2007). They have most often been working in the industry between 11 to 20 years, and in a permanent offshore position (PSA, 2007). The majority of offshore oil workers work onboard fixed installations, and as previously mentioned, the majority of the employees are employed as contractors in the offshore hierarchy. The NCS has recently been described as a mature shelf with ageing platforms and it is therefore assumed that the need for contractor companies conducting maintenance and modification tasks will increase in the years to come (Tharaldsen, Olsen, & Rundmo, 2008). Furthermore, according to the Petroleum Safety Authority (PSA, 2008) large scale expansion and modification projects, both onshore and offshore, has contributed to the establishment of new contractor companies, and also contributed to the expansion of already existing contractor companies.

In sum, work in the offshore oil and gas industry poses a variety of threats to employee health and well-being. The extensive changes that have occurred within the industry during the last years will continue to have impacts on the safety and the health of the employees' working there. Due to these changing circumstances, the health, safety and productivity of the workforce are issues of concern, not only to employees on the platforms, but also to the industry and to the onshore community at large. The following sections of this thesis will direct its focus towards employee health.

## **1.5 Health**

A person's subjective evaluation of their health status depends not only on the person's role in the workplace. A number of elements are incorporated, and subjective health evaluations are related to factors intrinsic to the individual (e.g. personality factors, life conditions) and aspects of the person's environment (e.g. occupational status, socioeconomic status, family and the environment). The World Health Organisation (WHO) has stated that "Health is a state of complete physical, mental, emotional, spiritual and social well-being and not merely the absence of disease or infirmity" (WHO, 1948). Included in this definition are physical, social and psychosocial aspects of health. The WHO definition also abandons the exclusive emphasis placed on the physical or medical aspects of health that have been typical of previous definitions, recognising that health status can vary in terms of a number of dimensions (i.e. physical, mental and social) and emphasising well-being as a criterion for good health, thereby abandoning the traditional perspective of defining human health in purely negative terms. According to the WHO definition, it is crucial that health is seen as a subjective phenomenon. Implicit also is that illness is a subjective state, i.e. the individual perception of not being well. Accordingly, to obtain information on health, it is important to ask the individual, and self-reported health is generally seen as a valid measure (Miilunpalo, Vuori, Oja, Pasanen, & Urponen, 1997; Goldman, Gleib, & Chang, 2004).

In essence there are two different ways to measure health in the occupational context (Lindholm, Dejin-Karlsson, Westin, Hagstrom, & Uden, 2004). It can be assessed either through an objective examination by a physician or by a self-evaluation of subjective health status. Objective measurements of health have, in previous studies, been shown to be relatively poor predictors of a person's future health status. The self-evaluation method seems to be a better overall measure to predict health in the group used in the present context, i.e. initially healthy employees in the oil and gas industry. The present work used both evaluations of *symptoms* of ill-health (e.g. musculoskeletal complaints, hearing impairments and psychological complaints) and self-reported general current health status. Measures of general health status differ from other health measures in that they do not focus on a specific dimension of health. Instead, such measures ask respondents for an overall assessment or self-rating of their health status in general (Baron-Epel & Kaplan, 2001).

Subjective evaluations of specific complaints (e.g. pains in shoulders, arms, sadness and depression) were used to measure self-reported health status in the present work. Tveito (2006) described subjective health complaints as the everyday complaints we are all bothered by, but, in most instances, not bothered enough to seek medical assistance or take absence from work (Tveito, 2006). Recent research has shown that subjective health complaints are prevalent in the general Norwegian working population (Svensen, Arnetz, Ursin, & Eriksen, 2007). In other words, these health problems are not necessarily pathological. Nevertheless, they are often cited as reasons for work related ill-health and sickness absence (Tveito, 2006; Waddell & Aylward, 2005). Recent studies in Norway for instance show that musculoskeletal complaints, are by far, the largest contributing factor to sickness absence, followed by psychological complaints (Ose, Jensberg, Reinertsen, Sandsund, & Dyrstad, 2006).

The subjective assessment of *general* health reflects an individual's integrated perception (i.e. of biological, psychological and social dimensions) and represents a summary statement concerning the ways the various aspects of health (subjective as well as objective) are combined within the individual's perceptual framework (Kaplan & Baron-Epel, 2003; Miilunpalo et al., 1997; Bardage et al., 2005). Research has indicated that individuals include several aspects of health, such as mental, physical and social, into account when evaluating their self-reported or general health status (Niedhammer, Tek, Starke, & Siegrist, 2004). A further advantage in using employees' self-evaluation of health is that responses can be collected easily through a self-administered questionnaire, and hence, represent cost-effective means of health assessment (Baron-Epel et al., 2001).

Within the Norwegian oil and gas industry there has been an extensive focus on safety, but relatively less attention has been directed towards the concept of health. It has been stated that the health concept has had a "Cinderella" status within the industry, implying that health issues have gained relatively little attention as compared to the issues of safety and risk (Gardner, 2003). The health area has been less in focus, partly because it has been regarded as a topic best left to medical specialists. Furthermore, it has been difficult to establish a cause-and-effect relationship between work in the oil and gas industry and chronic, long-term ill-health effects, i.e. the health effects may differ in the short and long-term for the employees (Head et al., 2007).

### **1.5.1 A healthy workforce?**

Obvious illness among offshore oil workers is relatively rare (Gardner, 2003). It has been stated that there is a degree of self-selection in the choice of occupation in terms of intellectual demands, physical and mental health demands and some adaptive personality traits (Punnett & Wegman, 2004; Wilhelm, Kovess, Rios-Seidel, & Finch, 2004). The assumption is that offshore work attracts a specific group of people, with the personality traits and the physical, mental and intellectual abilities that match the demands placed on the worker in the industry. This has been corroborated in earlier research, where Parkes (1998) conducted a survey among 172 offshore control room operators. She found that overall this group of workers showed stable “extravert” personality traits (Parkes, 1998), a characteristic typically associated with adaptability, emotional resilience and above-average mental health (Parkes et al., 2004).

Generally speaking, platform personnel are often described as forming a healthy work group reflecting the high medical standards required of them (Gardner, 2003; Parkes, 2007; Parkes, 1998). Employees working on the Norwegian continental shelf must undergo biannually a medical examination to ensure that they are physically and mentally fit and prepared to meet the demands associated with offshore work. “Fit” and “prepared” in this context implies that the worker must be able to perform offshore work tasks in a safe and effective manner, without risk to his or to other personnel’s health and safety. The health requirements associated with offshore work can be attributed partly to the physical and psychosocial stressors associated with offshore work, but also to the often remote and isolated location of an offshore oil installation, which is often far away from extensive medical assistance (i.e. hospitals). In addition to the medical fitness requirement, all employees must undergo basic survival training, including training in sea and helicopter safety training. In spite of the health and safety standards required of offshore oil and gas workers, it has been estimated that costs associated with work-related illness on the NCS is in the order of 370 to 900 million Norwegian Kroner (NKR) per year (ECON, 2005). The large cost is associated primarily with uncertainties about the proportion of health problems that are actually work related. It has additionally been estimated that approximately half of the Norwegian offshore workforce will be forced to retire prior to the ordinary retirement age (Morken, Tveito, Torp, & Bakke, 2004), which in the Norwegian oil and gas industry is 67 years of age for contractor employees and 65 years of age for operator employees. Also, older employees in Statoil (i.e. above 58 years of age)

were offered a severance package stating that they could keep 70 per cent of their salary until the ordinary Norwegian retirement age.

Previous studies that have examined offshore workers' health and well-being have shown that offshore work has often been associated with elevated levels of self-reported stress. Stress, in turn, has been demonstrated to be a major occupational health problem and has frequently been cited as a powerful cause of occupational ill-health (Danna & Griffin, 1999; Teasdale, 2006). Experience of stress within the workplace, particularly over prolonged periods of time, has been associated with adverse outcomes, such as physical illness (e.g. musculoskeletal pains), mental illnesses (e.g. depression), interpersonal conflicts, reduced performance, increased absenteeism and increased turnover (Cooper, Dewe, & O'Driscoll, 2001; Darr & Johns, 2008; Sutherland & Flin, 1989). As mentioned previously, perceived occupational stress in the oil and gas industry stems from a large variety of organisational, physical and psychosocial factors. For instance, a strong and positive association has been found between absenteeism and ratings of physical and psychosocial aspects on offshore drilling rigs and platforms. Moreover, research evidence indicates that workers perceiving psychological stress at work are more likely to experience occupational injuries and accidents. This was shown in a study including data from 27 construction sites in Hong Kong (N=740) (Siu, Phillips, & Leung, 2004). Relative to the offshore oil industry, Rundmo (1992) demonstrated in a study of 915 Norwegian offshore oil employees, that job stress factors, such as lack of influence over job decisions and the predictability of what can be expected from others, affected both perception of risk (i.e. regarding sources of risk in the work environment, such as falling objects, blow outs and evacuations) and safety perceptions (e.g. management commitment and safety preventive measures) (Rundmo, 1992).

Perception of occupational stress has in previous research, been related to ill-health effects, such as musculoskeletal pains (e.g. upper extremity disorders), and is also the most frequently cited health complaint among Norwegian offshore oil and gas workers (Morken et al., 2004). For instance, a large cross sectional survey conducted by the PSA in 2003 (as a part of the "Trends in Risk Level project") showed that 39 per cent of the respondents had experienced musculoskeletal complaints during the last three months. Similarly, Parkes and Swash (2000) found in a study of sickbay consultations made by personnel onboard three offshore oil installations on the UK continental shelf between 1993 and 1998, that respiratory and musculoskeletal disorders were the most frequent types of health



problems amongst UK offshore oil personnel (Parkes et al., 2000). Correspondingly, Chen and colleagues (2005) conducted a study involving 581 Chinese offshore oil and gas workers, and defined occupational stress according to nine sources. These were: 1) the physical environment of the workplace, 2) safety perceptions, 3) the interface between job and family/social life, 4) career opportunities and achievements, 5) organisational structure, 6) ergonomics, 7) management problems and the relationship with others at work, 8) the managerial role and 9) the living environment. The results from Chen and colleagues' (2005) study showed that stress from safety requirements, the physical environment and from ergonomics were the most important predictors of musculoskeletal pains among the participating workers.

Although the most common form of occupational ill-health in many of today's industrial nations is musculoskeletal pains/problems (Whysall, Haslam, & Haslam, 2006), research has also shown that mental disorders, and in particular depression, are quite common in the general working population (Sinokki et al., 2009). Relative to the oil and gas industry, previous research has shown that the perception of stress at work can predict mental health problems, such as depression (Chen, Wong, & Yu, 2009). Research has also shown that offshore personnel, particularly those in the older age ranges, tend to report higher levels of generalised anxiety than their younger colleagues. It is assumed that the favourable personality traits of offshore workers in general, as well as the high health standards required of them, indicates that environmental factors might underlie the anxiety observed among these workers.

Compared to employees in onshore based industries, it has been stated that offshore employees experience a higher degree of free floating anxiety, higher symptom scores on the General Health Questionnaire, feel more mentally and physically tired after work and that their working hours and shift patterns are more detrimental to their health and safety (Cooper et al., 1987; Parkes, 1992; Smith, Lane, & Bloor, 2001). Parkes (1998) found support for this statement in a survey of 172 control room operators offshore, who reported more anxiety, sleep problems, dissatisfaction with shift schedules and a higher perceived workload as compared to their onshore counterparts. However, results seem inconclusive in terms of onshore and offshore health perceptions. Parkes and Byron (2001) collected survey data from 909 workers employed by five operating companies at eight oil and gas processing sites in the UK (Parkes et al., 2001). Their results showed that measured anxiety and somatic symptoms were significantly higher amongst onshore personnel as

compared to offshore personnel. Further, a study examining job satisfaction and health in relation to changes in employment situation in a sample including onshore and offshore employees showed that employees onshore and offshore reported differing types of health complaints (Parkes & Razavi, 1997b). Their results showed that although minor health complaints were frequently reported among both onshore and offshore personnel, headaches were more frequent among onshore workers, while other health problems, such as musculoskeletal pains were more often reported by offshore oil workers (Parkes et al., 1997b). In addition to ill-health complaints associated with offshore work, it has also been shown in earlier research that offshore workers report high levels of unhealthy lifestyle habits, for example lack of exercise, smoking and poor dietary habits, which have been identified as risk factors for coronary heart diseases and other health complaints (Mearns & Fenn, 1994).

Platform type has been shown to be of importance in employee health perceptions in the offshore working environment. Research has demonstrated that employees onboard fixed platform perceive their mental health status as better as compared to employees working onboard drilling rigs and onboard larger installations. In addition, job type seems to be an important predictor for employee perception of health and well-being in the offshore work environment. Results from a study conducted by Parkes and Clark (1997a) amongst employees on the UK continental shelf, showed that experienced anxiety varied significantly with type of job performed at the platform. Their results showed that catering personnel, production personnel, management and drilling personnel reported higher anxiety scores than the remainder of the work groups. Type of job performed also influenced the experience of musculoskeletal pains and headaches. Parkes and Clarks (1997a) results showed that drilling personnel reported higher incident levels on both the before-mentioned health complaints (Parkes et al., 1997a).

In main, the abovementioned studies concern employees on the UK continental shelf, and generally speaking, relatively few studies have examined the Norwegian offshore employees' perception of health status relative to health and safety. The industry's attention has been more directed towards technological aspects of the working environment and the safety of the employees. The health concept has, to a large extent, been "subordinated". Nevertheless, employee health is considered important, mainly due to the enormous cost, both personal and economical, in relation to offshore life. In addition, to be able to address the issue of developing a "sound" health, safety and environment

culture, it is assumed that studies have to conduct more specific examinations of the health concept relative to the concepts of work environment and safety in the oil and gas industry, as well as how to examine more thoroughly what the concept should entail.

The relationship between work-related variables and health has been extensively studied within the occupational health research literature. The next sections of this introduction will therefore examine existing research literature, as well as central theories trying to account for the dynamic relationship between work and health. The presented theories have been important sources of inspiration for the presented work.

### ***1.6 The relationship between work and health***

The importance of work and safety for subjective evaluations of health goes beyond traditional work-related diseases caused by physical, chemical and biological hazards (Kivimaki, Elovainio, Vahtera, & Ferrie, 2003). Generally, occupational health aims to promote and maintain the highest degree of physical, mental and social well-being of workers in all occupations; to prevent decline in health caused by working conditions; to protect workers from hazards resulting from factors adverse to health and to place and maintain the workers in an environment adapted to their psychological, physiological and social capabilities. It is generally acknowledged within the occupational health field that conditions at work – from an organisation's health, safety and risk practices, to work design and issues concerning basic ergonomic aspects, together with individual characteristics – can influence perceived health status and employee well-being in the organisational context (Danna et al., 1999; Niedhammer, Chastang, & David, 2008; Voss et al., 2001; Smith, Huang, Ho, & Chen, 2006; Kelloway & Day, 2005). Furthermore research suggest that psychosocial factors, such as perception of low social support and high work load, may have an adverse effect on employee health and well-being (Piiirainen, Rasanen, & Kivimaki, 2003). Psychosocial factors, such as those mentioned previously in the thesis, have been related to adverse health outcomes, such as musculoskeletal pain, psychological distress, reduced performance, reduced commitment to the organisation and also increased absenteeism (Bongers et al., 1993; Karasek et al., 1990; Landsbergis, 2003; Reynolds, 1997).

### **1.6.1 Theoretical accounts of the work-health relationship**

Richard Lazarus (1966) was one of the first to incorporate the “human” element into the stress process, by using the concept of “psychological stress” in his transactional stress theory (Lazarus, 1966). Psychological stress was defined by Lazarus and Folkman as “a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being” (Lazarus & Folkman, 1984, p. 19). Hence, psychological stress was conceptualised as a multivariate and dynamic process involving both input from the external environment and output in terms of the individual’s response to the external environment. The transactional theory of stress posits that the effect of a potential stressor on health and well-being is dependent on cognitive processes whereby the individual appraises the degree to which a potential stressor will be perceived as threatening, and shapes the individual’s judgement of available resources to cope (Conway, Campanini, Sartori, Dotti, & Costa, 2008). A key determinant of successful coping in the workplace is an individual’s perception of how much they can control the outcome of the work environment itself (Huang, Ho, Smith, & Chen, 2006). The implication is that situations are not inherently stressful, but become a source of stress only if the individual interprets an environmental stressor as a threat to their health, safety and well-being. Hence, employees will perceive sources of stress in the working environment differently and therefore, they will affect their health status in diverse ways depending on the individual’s subjective evaluation of a given situation. This means that job stress signifies a poor fit between the demands of the work environment and what the individual is equipped to handle (Jeong, 1998).

Two theoretical models in particular have influenced research within the occupational health field. These are the demand-control (D-C) model and the effort-reward-imbalance (ERI) model. These models have generated enormous amounts of research evidence concerning the explanation of work-related ill-health. These theories will be reviewed shortly in the following sections of the thesis.

#### **1.6.1.1 The demand-control model**

One of the most influential and fundamental theoretical models describing the relationship between social and organisational workplace factors and employee health, is the demand-control model (Bambra et al., 2009; Torp, Grogard, Moen, & Bratveit, 2005). This also was the initial inspiration for the work presented in this thesis. The demand control (D-C) model was originally developed by Karasek (1979) and further refined by Karasek and

Theorell (1990) (Karasek, 1979; Karasek et al., 1990). It represents an organisation based perspective focusing specifically on psychosocial workplace factors. The D-C model explains employee psychological and physical ill-health in terms of workplace conditions and postulates that changing the work organisation can improve worker health (Van Yperen & Snijders, 2000). Through the work by Johnson and Hall (1988), the model was expanded to include a measure of social support (Johnson & Hall, 1988). The latter model was called the demand-control-support model, or the iso-strain model, and places emphasis on the buffering effect of perceived social support in the relationship between high job demands and low perceived control. Hence, it is the combination between (high) demands, (low) control and (low) support which is thought to be the cause of strain and increased risk of illness (Morrison, Payne, & Wall, 2003; Tsutsumi et al., 2004).

According to the original demand-control model (Karasek, 1979), psychological and physiological ill-health symptoms have their origin in the accumulation of residual stress. This implies that perceived job demands place the individual in a “motivated” state, and if nothing can be done about this state due to a lack of job control, the unreleased stress has adverse effects upon the individual’s health and well-being. Four, distinctly different job conditions can, according to Karasek and Theorell (1990), be discerned on the basis of the two dimensions, i.e. psychological job demands and decision latitude. The first condition is termed “high strain jobs” (i.e. high job demands and low control), and involves the most adverse reactions of psychological strain and hence, deteriorating effects on employee health and well-being. The second condition has been named “active jobs” (i.e. high demands and high control). Workers in this condition are thought to be more actively involved in a range of positive activities, both within and outside the worksite. In contrast to the active jobs, workers occupying “passive jobs” (i.e. low job demands and low control) encounter few challenges and few opportunities for growth, and as a consequence become less involved in their work. The fourth job condition, as identified in the D-C model, has been named “low strain jobs” (low degree of job demands and high degree of control).

Research evidence regarding the demand-control model have produced mixed results (Bishop et al., 2003). The consistency of the model has been high as far as the control dimension of the model is concerned. However, consistency has been mixed with regard to tests of the full model, i.e. with respect to the interaction between psychological job demands and perception of control (Beehr, Glaser, Canali, & Wallwey, 2001). Van der

Doef and Maes (1999) reviewed 20 years of empirical research on the D-C model, including 31 studies (van der Doef & Maes, 1999), and they found that only 15 of these studies supported the interaction hypothesis between job demands and perceived control, as proposed by Karasek and Theorell (1990). Due to this finding, it has been argued that the use of more occupation-specific measures of psychological demands and perceived control could improve the prediction of employee health and well-being (deJonge, Dollard, Dormann, Le Blanc, & Houtman, 2000b). By using specific, well-defined occupational groups, deJonge and colleagues (2000b) found support for the full model (i.e. the interaction between job demands and job control) in a sample of 2485 service sector workers (e.g. health care, transport). Health and well-being were conceptualised in terms of emotional exhaustion and psychosomatic health complaints (e.g. headaches). Their study also provided empirical support for the postulation that active jobs (i.e. high demands and high control) give rise to positive outcomes, such as positive challenges at work and increased job satisfaction (deJonge et al., 2000b). Furthermore, these results have been supported by an increasing amount of research indicating that perception of control at work is associated with positive health outcomes, such as decreased anxiety and depression, less psychosomatic health complaints and increased job performance (Carayon, 1993; Greenberger, Strasser, Cummings, & Dunham, 1989; Mullarkey, Jackson, Wall, Wilson, & Grey-Taylor, 1997). Some research evidence, however, has found support for the association between high strain jobs and elevated risk of emotional exhaustion, increases in psychosomatic health complaints and physical health symptoms (deJonge et al., 2000a). Also, tests of the “iso-strain” model indicate that the perception of high psychological job demands, low control and perceived lack of social support are related to ill-health outcomes, such as increased rates of burnout (Houkes, Janssen, de Jonge, & Bakker, 2003), and psychological strain reactions, such as depression and anxiety (Beehr, Jex, Stacy, & Murray, 2000).

A second model that has received much attention in the occupational health field is the effort-reward imbalance model (ERI model). Whereas the D-C model has been described as a situation specific model, the ERI model has placed work into a wider social setting, focusing on the social reciprocity inherent in the work role (Bambra et al., 2009). A short account of the ERI model is provided in the following section.

### **1.6.1.2 The effort-reward imbalance model**

The effort-reward imbalance model (ERI model) was intended to acknowledge an individual's "need for control" (Siegrist, 1996). The model emphasises that the work role offers a person possibilities to contribute and perform, to be rewarded or esteemed, and to belong to some significant group (Tsutsumi et al., 2004). The model builds on the concept of distributive justice (Siegrist & Marmot, 2004), and assumes that efforts at work are spent as part of a social exchange process to which society at large contributes in terms of rewards channelled through money, esteem and career opportunities (Shannon et al., 2001; Bambra et al., 2009). When the norm of social reciprocity is violated, an imbalance will result in "recurrent feelings of threat, anger and depression or demoralisation which in turn evoke sustained autonomic arousal", leading to ill-health effects for the worker (Siegrist, 1996). The ERI model also incorporates a personal pattern of coping mechanism associated with specific work-demands, termed "over-commitment". Over-commitment defines a set of attitudes, behaviours and emotions that reflect excessive endeavour combined with a strong desire for approval or esteem (Tsutsumi et al., 2004). Research regarding the ERI model has shown that violations of the social contract (defined in terms of high efforts spent at work in combination with low rewards gained from work) is related to an increased risk of cardiovascular disorders, reduction in mental and physical health functioning and also to an increased risk of alcohol dependence in men (Head, Stansfeld, & Siegrist, 2004; Kuper, Singh-Manoux, Siegrist, & Marmot, 2002).

The theoretical accounts of the work and health relationship can be summarised by stating that an optimal psychosocial work environment, i.e. one that is conducive to good employee health, is one that is optimally adapted to individual capacities. This means that the employees have a satisfactory amount of influence over their work tasks and that they receive the proper amount of support from their co-workers and supervisors. A good balance should be upheld between amount of effort spent at work and rewards received in return (Karasek et al., 1990; Siegrist, 1996). However, an optimal psychosocial environment must also exist in the context of an organisation. The next sections will look at organisational level variables, i.e. organisational culture/climate, and more specifically, the concept of safety, and safety culture/climate in an organisation.

## **1.7 Organisational level factors**

An organisation is a group of people intentionally structured together to accomplish an overall, common goal, or a set of goals. Its purpose is to create an arrangement of positions and responsibilities through which an enterprise can carry out its work, and be competitive and effective in its operational environment. The organisation's success in the operational market is a result of factors, such as managerial actions, sector influences and extra institutional influences (e.g. technological, socio-political and other environmental influences). Implicit in the concept of an organisation is also that people in an organisation must have a shared history, which has evolved over time, and acts as a stable entity (Schein, 1990). An organisation sets its goals to develop strategies in response to the requirements imposed by the changing environment (Hsu, Lee, Wu, & Takano, 2008). These goals are developed for every facet of the organisation, and are often formulated in company vision statements or values, such as Statoil's four core values: "courageous", "open", "hands-on", and "caring". These values are thought to "embody the spirit and the energy of StatoilHydro at its best", and they are "essential for us to succeed over time" (Statoil, 2009). The organisation must also develop strategies, policies and procedures in order to attain these goals. Policies, procedures and goals are facet specific, meaning they must be developed for every aspect of organisational functioning, e.g. customer service, production and safety (Zohar, 2002). In sum, an organisation's functioning implies the means by which a certain organisational structure is accomplished and maintained.

Organisations can vary enormously in size and complexity. A common feature, however, is that they are designed to accomplish important goals to ensure their survival in the external operational environment. Generally, industrial organisations have become increasingly complex and fast paced (Leveson, 2004; McLain & Jarrell, 2007; Perrow, 1984), and this is also the case for organisations operating within the oil and gas industry. In addition to multiple goals, multiple interacting partners and complex social structures, industrial organisations' also encompass uncertainties in the complex technology and the hazardous environment in which they operate. An organisation is structured with different hierarchical levels, such as departments, divisions, work teams etc, to provide the formal interrelationships between management and other levels and staff within the organisation. For an effective, productive and safe organisation there must be cooperation between all levels: top-level managers must establish the foundation for a positive safety climate/culture, supervisors must demonstrate caring attitudes and good examples,



maintenance employees need to keep the equipment operating safely and operators must establish sustainable and safe work habits (DeJoy, Schaffer, Wilson, Vandenberg, & Butts, 2004; Prussia, Brown, & Willis, 2003; Thompson, Hilton, & Wilt, 1998).

Safety hazards are unavoidable in many occupations, and working in a complex industrial organisation that has a strong and visible commitment to employee health and safety, is believed to have a positive impact on the safety and health of the workers (Lundstrom, Pugliese, Bartley, Cox, & Guither, 2002; Mearns & Reader, 2008). The implication is that a satisfactory level of HSE standards is not achieved in isolation. The worker in a hazardous occupation is embedded in a complex social and technological system composed of several influential sub-systems, including production requirements, safety hazards, different types of management and organisational procedures and policies.

### **1.7.1 Organisational culture and climate**

In the research literature, there is some confusion regarding the distinction between the concept of organisational culture and the concept of organisational climate, and the relationships between these constructs remains unclear (Nielsen, Rasmussen, Glasscock, & Spangenberg, 2008). The culture and climate constructs have sometimes been treated as synonymous, although they are considered to be conceptually different (Schein, 1990). The term culture is often viewed as a more all-embracing concept than the climate concept. It has been argued that organisational culture has a *normative* focus, while the organisational climate concept has a more *descriptive* focus (Parker et al., 2003). The organisational culture, accordingly, represents a more stable form of organisational practice, whereas the climate concept represents a surface level, or “snapshot”, of the current state of the organisation (Hale, 2000; Shannon & Norman, 2009). Moran and Volkwein (1992) argued that the confusion between the culture and climate concepts in the organisational literature can be primarily attributed to two causes. The first is that there has been an absence of adequate definitions of the terms used. The second reason points to a failure to recognise that the culture and climate concepts have evolved from different academic disciplines, i.e. the culture concept stems from social anthropology, and the climate construct stems from social psychology (Moran & Volkwein, 1992). It has also been argued that the culture and climate concepts require different measurement tools. A study of the organisational culture necessitates research techniques, such as observation, interviews or field studies, while the organisational climate (and hence the organisation’s safety climate) can be assessed by using standardised scales and questionnaire surveys, due to the assumption that the

organisational climate is a temporal and relatively unstable aspect of the organisation. The organisational climate is also more subject to change depending on the features of the current environment or prevailing conditions; whereas the organisational culture is more resistant to change (Dallner et al., 2000; Zhang, Wiegmann, Thaden, Sharma, & Mitchell, 2002).

In the current thesis, the culture and climate constructs are assumed to be related, albeit not identical. The objective of the conducted work has been to assess the work safety climate rather than the work safety culture, and the studies included in the thesis are mainly based on scales and questionnaires. The safety culture and safety climate concepts are treated as more specific parts of the overall organisational culture/climate concepts. Therefore, the view adopted in this thesis can be summarised as depicted in Figure 1.4.

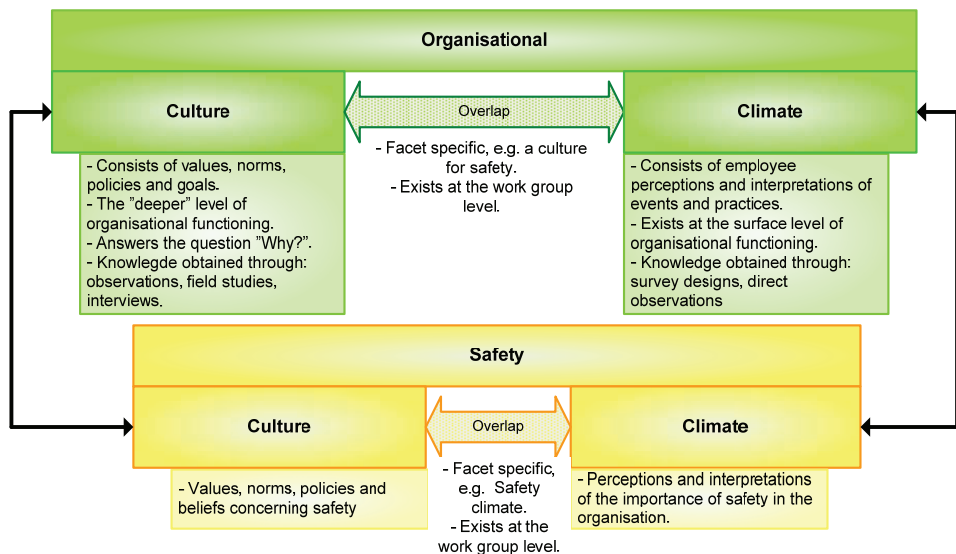


Figure 1.4 Conceptual contents of the organisational culture and climate constructs and the more specific concepts of safety culture and safety climate.

## 1.8 What is organisational and safety culture?

### 1.8.1 Organisational culture

An organisation's culture is widely acknowledged to be a critical factor regarding an organisation's success or failure (Glendon & Stanton, 2000; Zohar & Luria, 2005). The organisational culture is important because shared norms, values and beliefs are believed to influence employee perceptions, behaviours and their emotional reactions to the workplace

(Aarons & Sawitzky, 2006). Moreover, it has been argued that an organisation's culture is intended to solve a group's problems of survival in an external environment, as well as its problems of internal integration (Schein, 1990). The utility of the concept has previously been demonstrated with regard to an organisation's financial performance, to customer and employee satisfaction, to employee health and well-being and also to an organisation's state of safety.

A number of definitions have been offered to explain the organisational culture concept, but these definitions have tended to be vague and general and have resulted in a vast array of different conceptualisations and definitions (Guldenmund, 2000). It has, for instance, been stated that an organisation's culture provides a metaphor for understanding how it works and why it responds in specific ways to environmental influences (Waring & Glendon, 1998). Furthermore, it has been suggested that the organisational culture represents a complex framework of national, organisational and professional attitudes and values within which groups and individuals function (Helmreich & Merritt, 1998). The characteristics that have endured in most of the definitions of organisational culture however, are that culture represents the learnt set of values, assumptions and beliefs, that may take the form of practices reflected through fundamental values, norms, expectations and rules of behaviour in the organisation (Glisson & James, 2002; Harvey et al., 2002; Ostroff, Kinicki, & Tamkins, 2003). Organisational culture is additionally assumed to be stable, to be imparted to new members, and to influence how employees within the organisation relate to each other and how they relate to the work environment (Helfrich, Li, Mohr, Meterko, & Sales, 2007). It has also been described as a more global, superior construct (Guldenmund, 2000). It operates at a higher theoretical level relating, for instance, to a company's overarching policies and goals (one of which concerns safety). According to this perspective, the culture constitutes the driving force and provides the guiding principles behind an organisation's goal structure. Thus, culture shapes the means of attaining certain goals and is therefore, an imperative source to measure progress, as well as to serve as the foundation for correcting deviations from norms and expected outcomes (Ciavarella & Crowson, 2004).

A widely cited definition comes from Edgar Schein (1985). He defined organisational culture as

...a pattern of basic assumptions, invented, discovered or developed by a given group, as it learns to cope with its problems of external adaptation and integration, that has worked well enough to be considered valid and therefore is to be taught to new members as the correct way to perceive, think, and feel in relation to those problems

(Schein, 1985, p. 9)

Once a group has learned to hold common assumptions, the resulting patterns of perception, thought processes and feelings will become automated and therefore, provide comfort and security for the group members. This means that socially shared culture perceptions are valuable in situations where it is unclear which performance, facet or behaviour should be prioritised (Zohar & Tenne-Gazit, 2008). According to Schein (1992) any definable group with a shared history can develop a culture, and hence, there exists numerous sub-cultures in an organisation (Schein, 1992). However, according to Schein (1992), in addition to the sub-cultures, a shared or overarching culture will also exist for the organisation as a whole.

Schein's approach to culture has been labelled integrative (Richter & Koch, 2004). This is because his culture concept involves shared solutions and shared understandings, and represent the "social glue between its members" (Alvesson, 2001; Schein, 1992). Furthermore, organisational culture, according to Schein, is "something" that influences certain key variables in the organisation, such as safety. Schein (1992) uses three levels to describe an organisational culture. These are: 1) "the observable artefacts", 2) "the values" and 3) "the basic underlying assumptions". The first level, i.e. observable artefacts, includes visible organisational structures and processes. At this level, one finds elements, such as the physical layout of the organisation, the dress code, how people address each other, physical hazards, the tools used in work operations etc. This level comprises the observable part of Schein's culture concept. The second level, i.e. values, includes the organisations strategies, goals and philosophies. According to Schein (1992) this level includes the members' feelings and thoughts towards the organisation and events that take place within the organisational context. The third level in Schein's (1992) culture concept is the basic underlying assumptions. This level constitutes the deepest level of the organisational culture, and includes elements such as unconscious or taken for granted beliefs, perceptions and thoughts that influence employee behaviour. It is these taken for

granted, basic, shared assumptions that represent the most consistent characteristics of an organisational culture.

Related to Schein's conceptualisations of organisational culture, other authors have argued that the most accessible level of an organisation's culture is the overt behaviour, as shown by the organisation's members (Zohar et al., 2005). The reason given is that it is possible to decipher which values are important in an organisational context by studying how the employees act and behave. At an intermediate level, one finds the employees' attitudes and perceptions, and at the unobservable level one finds the organisation's core values. It has been suggested that the inner layer of culture (i.e. its basic underlying principles) can be derived indirectly from the behaviour of the individuals within the organisation (Glisson et al., 2002).

Hofstede (1990) also describes organisational culture as a concept consisting of multiple layers: norms and values – at the central core – rituals, heroes and symbols – collectively called practices (Hofstede, 1990). Only practices (i.e. rituals, heroes and symbols) are relevant to an organisation. The first layer, i.e. the central core, is “cultured” during childhood (through people's upbringing) and remains relatively stable throughout people's lives, i.e. these are the social values (Choudhry, Fang, & Mohamed, 2007). Guldenmund (2000) has summarised the debate concerning organisational culture by stating that it consists of seven central characteristics: 1) holistic, 2) stable, 3) multidimensional, 4) shared, 5) various aspects (e.g. safety culture), 6) practices (i.e. norms, values, rituals, heroes and symbols) and finally 7) functions/guidelines (e.g. the way we do things around here).

### **1.8.2 Safety culture**

The concept of *safety culture* represents a particular aspect of the organisational culture, and is often cited as a more focused part of the overarching organisational culture (Meshkati, 1999; Richter et al., 2004). The concept of safety culture was first developed by the International Atomic Energy Agency (IAEA), as a result of their analysis of the Chernobyl accident (Lee, 1998). It was coined in order to gain an overview, as well as to develop an indicator, of the level of safety in an organisation. The concept attempted to gain insight into the social and subjective factors affecting safety, such as attitudes toward safety and management commitment towards safety (Reiman & Oedewald, 2004). An organisation's safety culture was intended to refer to both the larger context and objectives

of the organisation, and the internal structures and resources needed to fulfil these objectives.

Several definitions of safety culture have been developed since the 1980s in order to make the concept understandable and operational. The one that has become most widely applied was developed by the Advisory Committee on the Safety of Nuclear installations (ACSNI).

It defined safety culture as

...the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to and style and proficiency of an organisations safety and health management

(ACSNI, 1993, p. 23).

A satisfactory safety culture involves the employees having the ability to deal with risks or hazards in the workplace in such a way as to avoid damage or loss, and still be able to achieve their overarching goals (Reason, 2000). An implicit premise in a positive safety culture is that the communication channels within the organisation are founded in mutual trust, based on the shared perceptions of the importance of safety, and on confidence in the efficacy of the preventive measures applied to ensure the safety and health of the employees (Gadd & Collins, 2002).

Along with trying to define the concept of safety culture, several different criteria have been developed to aid an organisation in the measurement and development of a good or positive safety culture (Grote & Kunzler, 2000). Pidgeon (1991), for example, argued that a positive safety culture is characterised by norms and rules for hazard management, the prevailing attitudes toward safety as well as how the organisation reflects on its safety practices in behaviours and attitudes (Pidgeon, 1991). Reason identified five core features characterising organisations that succeeded in the development of a satisfactory culture for safety (Reason, 1997):

- 1) The organisation has a *safety system* that collects analyses and disseminates information from incidents and near misses, as well as from regular proactive checks on the system.
- 2) The organisation has a *reporting culture* where people can report their errors, mistakes and violations.
- 3) The organisation has a *culture of trust* where people are encouraged, and even rewarded, to provide essential safety related information, but also in which it is clear where the line between acceptable and unacceptable behaviours are drawn.

- 4) The organisation has a *flexible culture* in terms of the organisational structure in the face of a demanding and dynamic task environment.
- 5) The organisation has the *willingness* and the *competence* to draw the right conclusions from its safety systems, and is willing to implement reforms when required.

Taken together, Reason's (1997) view of organisations with a satisfactory safety culture as rests on five core values and principles, i.e. an adequate safety system, the ability to foster trust, to be flexible, to be competent and to be open enough to allow employees to report their errors, mistakes and violations.

Another aspect of safety culture is that it can serve as a means for complex organisations to manage various safety and health risks in the workplace. In recent years, there has been a widespread view that organisations with a satisfactory safety culture, can guarantee the safety and reliability of the organisation. It is increasingly recognised that an organisation's poor health and safety record could potentially damage the company's reputation, so that one or more stakeholders view the company in a less positive manner. The utility of the safety culture concept has been supported by studies indicating that there is an association between a good or satisfactory safety culture and a lower frequency of occupational accidents in the workplace (Brown & Leigh, 1996; Gillen, Baltz, Gassel, Kirsch, & Vaccaro, 2002). This view implies that cultural factors are powerful underlying causes of occupational injuries, near-misses and accidents (Brown, Willis, & Prussia, 2000; Flin, Mearns, O'Connor, & Bryden, 2000; Glendon & Litherland, 2001; Hofmann & Stetzer, 1996; Huang, Chen, DeArmond, Cigularov, & Chen, 2007; Mearns, Flin, Gordon, & Fleming, 2001; Mearns, Whitaker, & Flin, 2003; Mohamed, 2002; O'Toole, 2002; Oliver, Cheyne, Tomas, & Cox, 2002; Rundmo et al., 1998; Tomas, Melia, & Oliver, 1999; Turner & Pidgeon, 1997; Wagenaar & Groeneweg, 1987; Weick, Sutcliffe, & Obstfeld, 1999; Zohar, 1980). However, the safety culture concept has also been criticised for being a "philosopher's stone", i.e. a cure to all ills in the workplace and an all-embracing mechanism used to factor into complex systems, psychological and human elements (Cox & Flin, 1998). Researchers in the occupational safety field have instead increasingly turned their attention to the concept of safety climate.

## **1.9 What is organisational climate and safety climate?**

### **1.9.1 Organisational climate**

The concept of organisational climate refers to shared perceptions among the members of an organisation with regard to organisational policies, procedures and practices (Coyle, Sleeman, & Adams, 1995; Denison, 1996; Drach-Zahavy, 2008; Rentsch, 1990). It represents a global impression of one's organisation and a personal impact of the work environment, which influences an individual's work behaviours and work related attitudes (Aarons et al., 2006). The organisational climate is believed to be more tangible, easier to measure and is often cited as a "snapshot" or a surface feature of the organisational culture (Gershon, Stone, Bakken, & Larson, 2004; Schein, 1990). Empirical research on the climate concept has typically focused on communication, leadership, social relationships at work and organisational performance, which are issues that may be associated with the physical, psychosocial and the organisational work environment (Rogg, Schmidt, Shull, & Schmitt, 2001).

The employees' perception of the organisational climate is thought to impact on how they perceive the organisation relative to particular aspects of functioning, e.g. factors associated with safety, risks and accidents (Siu et al., 2004). Such perceptions also affect workers' motivation (Brown et al., 1996), and their affective responses to the workplace and the working environment (DeJoy et al., 2004). Furthermore, research evidence has suggested that employees' perception of the organisational climate is significantly related to employee health and well-being (Stone, Du, & Gershon, 2007; Wilson, DeJoy, Vandenberg, Richardson, & McGrath, 2004). Perceptions of the organisational climate are thought to develop as workers attribute meaning to their organisational environment, for instance with regard to the overall importance of safety within the company. The relationship between the overall organisational climate and the more specific facet of safety climate has been investigated in recent research (Cooper, 2000; Neal, Griffin, & Hart, 2000; Silva, Lima, & Baptista, 2004). The results have demonstrated that the organisational climate predicts the safety climate, which in turn, is related to safety performance and the occurrence of occupational accidents and injuries within an organisation. Employee perceptions are central to the measurement of organisational climate (Griffin, Neal, & Neale, 2000), and it is assumed that that sub-climates may develop when employees, working in the same organisation, experience and perceive different work conditions (Gadd et al., 2002).



### **1.9.2 Safety climate**

The identification of an organisation's safety climate is, to a large extent, seen as an organisation's "proactive" stance towards managing safety and health issues within the workplace. It is thought to provide a significant contribution to the reduction of industrial accidents, and to effective ways of managing health and safety risk within the workplace (Lee & Harrison, 2000; O'Dea & Flin, 2001). While traditional approaches to managing workplace safety mainly focused on job redesign and the technical aspects of engineering, construction and operation, new approaches have, to a greater extent, directed attention at identifying organisational factors as important for the identification of accidents, injuries and near misses (Griffin et al., 2000; Mullen, 2004). Large scale accidents, such as the Piper Alpha incident on the UK continental shelf, have also illustrated that work safety climate and management processes are significant contributors to system failure (Neal & Griffin, 2006). The implication is therefore, that there is a link between "good safety" and "good business", i.e. a relatively large proportion of accidents, incidents and near-misses in the work environment can follow from unsafe acts that are derived ultimately from deficiencies in the organisational safety management systems.

Organisations can be viewed as having a number of specific climates, and the safety climate is one specific type that is perceived, experienced and interpreted by the employees (DeJoy et al., 2004; Zohar, 2002). Some authors, e.g. Zohar and Luria (2005), have stated that the safety climate concept is "facet specific", meaning that a climate exists for several aspects of organisational functioning, such as a climate for safety, customer service, innovation, productivity, health, etc. The assumption is that the general organisational climate will exert an influence on these facet specific climates, e.g. safety, which in turn will affect workers safety performance and subsequently their accident involvement (Gyekye & Salminen, 2005). The organisational safety climate is influenced by the employees perception of the psychosocial work environment, the physical environment and organisational characteristics, e.g. centralisation and formalisation, formal and informal relationships within the workplace and the personalities of organisational members and the leadership practices (Basen-Enquist, Hudmon, Tripp, & Chamberlain, 1998).

There is some debate in the research literature regarding the definition of safety climate, and at present, there is little consistency in the results achieved when attempting to define

and measure what the concept should entail (Evans, Glendon, & Creed, 2007). Nevertheless, different proposed definitions of the safety climate concept generally include that it is a psychological concept, which incorporates the employees' shared perceptions of the safety status within the workplace (Clarke, 2006). Zohar (1980), who originally coined the term safety climate, suggested that an organisation's safety climate consists of a summary of employees shared perceptions of management commitment and performance with regard to safety policies, practices and procedures. Another definition was proposed by Lindell (1994), and stated that safety climate is the workers' interpretations of features, events and processes in the work environment that are of relevance to the employees' perception of personal safety (Lindell, 1994). The assumption behind this definition is again, that employees observe continuously their work environment and the actions of their fellow workers as well as their superiors. The employees use these observations as a basis for the creation of cognitive models associated with safety (Varonen & Mattila, 2000), which in turn, forms the foundation for the work safety climate. Yet, other researchers have highlighted employee attitudes as the most important indicator of the work safety climate, arguing that employee attitudes often are framed as a result of all other contributing features of the work environment (Cheyne, Tomàs, Cox, & Oliver, 1999). The term safety climate has also been defined as the temporal measure of the state of the safety culture, subject to commonalities among an individual's perception of the organisation. This means it is situational and temporary in that it refers to the perceived state of safety at a particular place at a particular time, and is therefore, relatively unstable and subject to change (Zhang et al., 2002).

Perceptions of the work safety climate have been related to procedures regarding safety in the organisation. Procedures represent specific patterns that reflect the importance and prioritisation of safety over competing goals, such as efficiency. It has also been argued that perceptions of the safety climate inform the workers about which behaviours will be rewarded in the context of work (Zohar, 2000). Employees are continuously exposed to a number of (often contradictory and inconsistent) policies, procedures and practices within an organisation and they have to make sense of them by construing discrete policies and procedures as global patterns that are indicative of bottom line priorities in the workplace (Zohar et al., 2005). Employees search for perceptual cues or indicators in the work environment to aid the assessment of the relative priority of safety (Zohar, 2000). For instance, if workers perceive that their supervisors have allowed hazards to accumulate, this interpretation signals that the organisation carries a low commitment to employee

health and safety. Additionally, research indicates that employees' perception of the organisational investment in their health may be an important element with regard to the perception of the work safety climate. Mearns and Reader (2008), for instance, argue that organisations, by prioritising the health and safety of their employees, may highlight their commitment to these issues and thus enhance the employees' perceptions of the overall work safety climate (Mearns et al., 2008).

Although a vast amount of research has been conducted in the domain of safety climate during the past few years, researchers have failed to achieve consensus regarding the dimensionality of the concept. A wide range of themes or dimensions have been discussed. Zohar (1980), for instance, used eight dimensions to capture the complexity of safety climate. The measure was tested on an Israeli sample, and his work aimed to report characteristics that separated high and low accident-rate companies. Zohar's (1980) eight dimensions were: management's attitudes to safety; the effect of safe conduct on social status; the effect of safe conduct on promotion; the organisational status of the personnel safety representative; the importance of safety training; the level of risk at the workplace and the perceived effectiveness of enforcement versus guidance in promoting safety (Zohar, 1980). Brown and Holmes (1986), tried to replicate Zohar's eight dimensions, in an American sample of manufacturing workers (Brown & Holmes, 1986). Their analysis revealed a three-factor solution: employee perception of management concern about their well-being; management's activity in responding to problems about their well-being, and subjective perceptions of physical risk. Dedobbeleer and Beland (1991) tested this factor structure, using a sample of United States construction workers and found support for Brown and Holmes' (1986) three-factor solution, although their results indicated that a two-factor solution would better represent their data (Dedobbeleer & Beland, 1991). The two factors identified by Dedobbeleer and Beland (1991) were named: management commitment to safety and workers' involvement in safety activities. Thus, although there is lack of agreement in the research area regarding exactly which dimensions to include in the measurement and description of the safety climate concept, most studies seems to emphasise the importance of management (Cheyne, Cox, Oliver, & Tomas, 1998; Flin et al., 2000; Griffin & Neal, 2000; Lin, Tang, Miao, Wang, & Wang, 2008; O'Dea et al., 2001). In a review article, Flin and colleagues (Flin et al., 2000) considered 18 industrial surveys (from 1991 to 1998), and identified the most frequent or common themes in the safety climate research literature. These were: perception of management; perception of the safety system; perception of risk; perceived work or production pressure and employee

perception of personal competence. Flin and colleagues' (2000) common themes were employed to measure the work safety climate among offshore workers in paper III of this thesis.

The management's role in relation to safety climate primarily concerns attitudes and leadership behaviours as shown in safety behaviour and production (Cooper & Phillips, 2004; Huang et al., 2007). Zohar and Luria (2005) have argued that the managements' policies, procedures and practices represent the primary sources of reference for the employees' work safety climate perceptions. The management's actions affect directly an individual's perceived safety climate, and if the managers are committed to safety, it is more likely that the workers will show also a strong commitment to safety (Mullen, 2004). This statement can be related to the social exchange theory, and more specifically the norm of reciprocity. Employees view management's commitment to safety as indicative of the organisation's concern for their safety, and employees in turn, feel obliged to reciprocate with the appropriate safety related attitudes and behaviours (Zacharatos, Barling, & Iverson, 2005). A weakness in the mentioned studies, however, is the difficulty to identify the level of management being used. Each management level has distinct roles, and the workers perceive managers at different levels in the hierarchy in different ways. Such perceptions are therefore likely to influence the safety climate differently, depending on the level of management being investigated (Thompson et al., 1998). In the present thesis, the immediate management was used in paper III, to examine this dimension in the overarching concept of work safety climate.

Another commonly identified dimension in the safety climate literature concerns the organisation's safety systems (Flin et al., 2000). These include the organisation's safety committees, the personnel safety representatives, available safety equipment and the organisation's safety policies and procedures. The safety committee has been described as a forum that brings the management and the workers together, and provides an opportunity to develop communication and cooperation about safety in the work process (Gadd et al., 2002). Sawacha and colleagues (1999) also identified that safety committees are an important dimension in the workers' safety performance, proposing that organisations with effective safety committees are more likely to try to improve safety performance than organisations with less effective safety committees (Sawacha, Naoum, & Fong, 1999). Research has also indicated that the status of the personnel safety representative in the

organisation influences the employees' perception of the overall work safety climate (Cooper et al., 2004).

Employees' perception of risk has also been identified as an important variable affecting the work safety climate (Flin et al., 2000; Zohar, 1980). A wide range of issues related to risk perception and safety climate has been studied. This involves self reported risk taking behaviour, perceptions of risks at work and the workforce's attitudes towards risk. Generally, research has shown that workers' perceptions of risk are influenced by the context of their working environment (Mearns, Flin, & O'Connor, 2001; Cox & Cheyne, 2000), and that in the workforce of the same organisation, there will be different levels of perceived risk, depending on, for instance, type of work being conducted (Findley, Smith, Gorski, & O'Neil, 2007). Similarly, Mearns and colleagues (2001) argued that in the offshore environment, there exists different "worlds of risk" among the sub-groups or work groups in the same organisation. Two of the papers presented, as part of this thesis (papers I and III) examine work, safety and health perceptions in different sub-groups in the work environment (i.e. differences between different occupational groups in the onshore and offshore work environment). Different perceptions of risk are thought to develop as a result of occupational and situational factors, e.g. physical working conditions, psychosocial working conditions, work pressure and peer pressure.

Another factor that has been highlighted as an important impact on work safety climate, is the employees' perception that the company values safety issues over cost and expenditure. Managers can influence employee perception of the safety climate by clearly communicating the organisation's priorities and also by keeping safety issues visible during times of high work pressure and recession (Brown et al., 2000). Related to this, Hofman and Stetzer (1996) found that a perception of high workload was associated with an increased tendency to engage in unsafe acts by the employees. These authors attributed the main reason for this finding to the fact that people who perceived a high degree of performance pressure would focus their attention on completing the work, and less on the safety of their work procedures; thus making safety less of a priority in their work task execution (Hofmann et al., 1996).

Studies of the work safety climate at the group or organisational level have been linked to unsafe work behaviours (Brown et al., 2000; Cooper et al., 2004; Seo, 2005; Silva et al., 2004; Tomas et al., 1999). Brown and colleagues (2000) analysed data from 551

employees in the steel industry. Their results showed that a safety climate, characterised by an “open door” policy for hazard and accident reporting, a sincere concern for employee well-being and fairness in accident investigations, was associated with safer worker behaviour (Brown et al., 2000). Similarly, Seo (2005) argued that perceptions of the work safety climate influenced safety performance through three different paths simultaneously. These paths were: 1) indirectly through the influence of perceived work pressure affecting perceived risk, which influences perceived safety barriers (i.e. scepticism regarding the importance of safety procedures), 2) direct influence on perceived barriers that affect unsafe practices and 3) direct influence on unsafe behaviours (Seo, 2005).

Generally, research indicates that a favourable view of the climate of the organisation implies that the individual worker can perform their work within a safe and supportive environment, where they experience a sense of community with their colleagues and where the specific skills of the individual worker is recognised (Larsson, Pousette, & Torner, 2008). Previous research has demonstrated that workers who perceive the work safety climate in a more positive manner tend to experience fewer occupational accidents, engage in more safety related behaviours (e.g. wearing personal protective equipment), remain injury free and also experience a higher degree of job satisfaction and fewer health complaints, as compared to workers whose perception of the safety climate is less positive (Gyekye et al., 2005; Tomas et al., 1999; Peterson, 2004). More positive perceptions of the work safety climate have also been related to the workers’ attitudes towards safety, which in turn, are thought to affect the adoption of safe behaviours and practices (Diaz & Cabrera, 1997). For instance Probst (2004) found that positive perceptions of the work safety climate were negatively correlated with accident involvement, near misses and workplace injuries, in a survey including 136 production employees in a United States manufacturing organisation (Probst, 2004). However, it is important to note that the studies mentioned are mainly cross-sectional in nature, and hence, it is also more difficult to establish a cause and effect relationship between a positive safety climate and “positive” safety behaviours and reduced accident frequency. It might also be reasonable to use the argument of “reversed causation”, i.e. that good or satisfactory safety behaviours among employees, and a low accident rate within the organisation, are responsible for the employees’ perception of a good or positive work safety climate.

In sum, research has demonstrated that the employees’ perception of their organisation and their work environment contributes to the explanation of work-related health and well-

being (Elovainio, Kivimäki, & Helkama, 2001; Ahlgren, 2006). Furthermore, climate factors, such as management (i.e. both top-level and immediate supervisors) commitment and involvement in safety work, risk reductions as well as the degree of social support experienced from management, can contribute to reduce the perceived stress among the members of an organisation.

### ***1.10 Some individual factors in occupational accidents***

Occupational accidents are the end result of an unsatisfactory interaction with the work environment (Attwood, Khan, & Veitch, 2006b). Psychosocial research has attempted to identify both individual and organisational factors that underpin accidents and injuries in the workplace. One popular theory has been the accident proneness theory, suggesting that some persons are more predisposed to be involved in work accidents due to stable trait characteristics of the individual i.e. personality traits (Kirschenbaum, Oigenblick, & Goldberg, 2000; Visser, Pijl, Stolk, Neeleman, & Rosmalen, 2007). In this context, a stable individual accident-prone personality trait has an underlying “negative” implication, meaning that such a trait renders it difficult to change behaviour/attitudes towards safety and risk in the workplace. Another theoretical account that has inspired vast amounts of research is Heinrich’s domino theory of accident causation (Heinrich, 1936; Heinrich, Petersen, & Roos, 1980). Inherent in this theory is the idea of the domino effect. Heinrich (1936) postulates that there are five such dominos, namely: injury; accident; unsafe acts or conditions; fault by the person and faults in the social environment (Seo, 2005). The domino theory of accident causation suggests that removal of domino number three (i.e. unsafe acts) is the easiest way to reduce workplace accidents due to the assumption that 88 per cent of the accidents are caused by unsafe acts or behaviours by an individual.

The idea that stable personality traits make some people more susceptible to errors (and hence human errors are the main cause of accidents in the workplace) has gained a status of almost common sense knowledge in current society. The implication of these theoretical accounts is that it simplifies the process of identifying individuals who are more prone towards experiencing accidents, and thereby make accidents more preventable. However, the problem with this kind of theory is that the person is regarded as a passive organism, blindly responding to their environment; this is because stable personality traits are difficult to influence or alter.

The trend for leading organisations to integrate employee health and safety into mainstream management has sparked a search for new accident causation models, which recognise that organisational and workplace factors are at the root of most unsafe acts. Therefore, more recent approaches that explain the occurrence of occupational accidents instead highlight the systemic and organisational aspects of work. The assumption is that most accidents at work are caused by the interaction between forces in the social and technical environments (Perrow, 1984). The technical and social components are parts of a system and interact with human thought processes and attitudes to influence outcomes, i.e. an accident or near miss at work (Prussia et al., 2003). Another influential accident causation model has been proposed by James Reason (1990). Reason defined two broad categories of error: active and latent failures. Active failures are consequences that are felt almost immediately, while latent failures are associated with the front-line operators whose adverse consequences lie dormant in the system, only to become evident when they combine with other factors to breach the system's defences (Reason, 1990). In later versions of this theory, which has been labelled the "Swiss cheese theory of accident causation", three system levels were included: unsafe acts, workplace factors and organisational factors (Reason, 1997). The system as a whole produces failures when all of the holes in an organisation's defence and barriers align, producing "a trajectory of accident opportunity" so that hazards passes through all of the holes in all of the defences, leading ultimately to failure.

An accident at work is increasingly seen as a weakness of the organisation as a whole (Mearns et al., 2003). Inherent in this view is that the occurrence of occupational accidents can be predicted by certain factors that are indicative of an organisation's state of safety (O'Dea et al., 2001). Furthermore, there is extensive evidence supporting the relationship between risk perception, perception of work safety climate and workplace injuries and accidents (Gabel & Gerberich, 2002; Huang et al., 2006; Mearns, Flin, Gordon, & Fleming, 1998; Oliver et al., 2002; Siu et al., 2004).

### ***1.11 Approach of the current thesis***

Safety has to be one of the dominant features of high risk industries, such as the oil and gas industry. Accidents or serious incidents, for instance the oil spill on the Statfjord A field, are associated with enormous financial losses for the organisation, for the employees working there and for society at large. To achieve the goal or "vision" of safe operations without serious injuries to personnel and the environment (i.e. work environment and

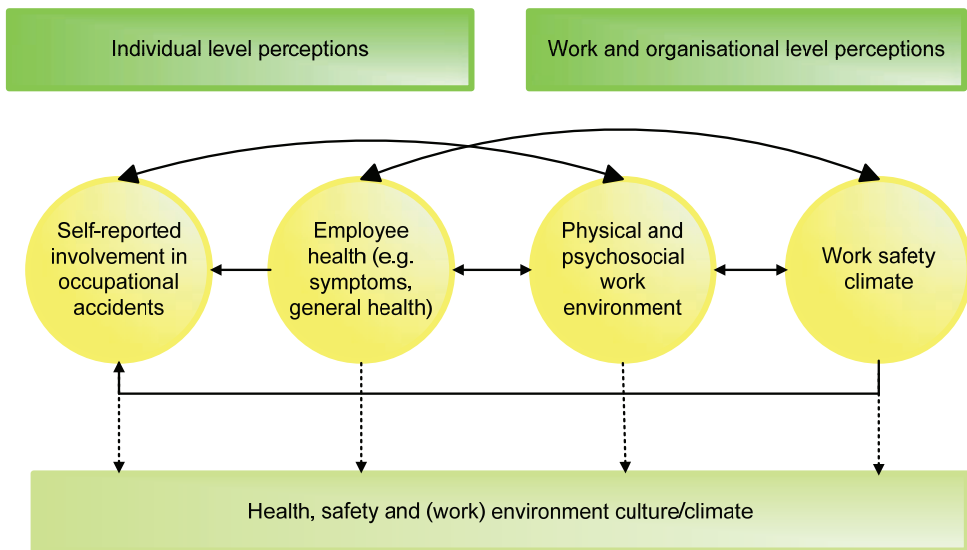


natural environment), there has been an increasing recognition that there is a broader cultural dimension involved in safety. There is also an increasing awareness of the need to understand the attitudes, beliefs, values and basic assumptions that influence how people perceive safety issues within an organisation. It is argued in this thesis that the psychosocial aspects of the work environment, as well as the health aspects associated with work in the oil and gas industry, have been less in focus than the safety aspects of the composite notion of HSE.

The reviewed theoretical and empirical work indicates that there is an association between level of safety obtained within an organisation and the employees' perception of health and well-being. Some studies indicate that the number of accidents experienced in the workplace can be related to how the employees perceive their surroundings, e.g. in terms of management commitment and risk perception within the organisation. In the current thesis, the employees' perceptions of the work safety climate and the physical and psychosocial work environment were conceptualised as the employees' perceptions of work and organisational level variables, whereas employee health and self-reported accident involvement were conceptualised as individual level variables. It was assumed, based on the work and health theories and especially the literature on organisational climate, that the work and organisational level factors would influence how the respondents perceive their (self-reported) health status and also their self-reported accident involvement.

A central aim of the present thesis was also to examine empirically the work and health relationship in the Norwegian oil and gas industry and within the HSE culture/climate framework, particularly in a number of different occupational groups. Regarding employees in the Norwegian petroleum industry, relatively few studies have examined these subgroup relationships in greater detail. Additionally, few studies have examined the relationship between work, health and safety in greater detail. It was also deemed as important to examine causal relationships, i.e. the *effect* of work safety climate upon employee health and well-being. Studies have examined these relationships among employees on the UK continental shelf, but relatively few have examined these associations among Norwegian oil and gas employees. An overall aim was to contribute to the improvement of, as well as the understanding of the composite notion of HSE in the oil and gas industry.

This introduction has presented the background for the conceptual model utilised in the thesis. It has outlined the rationale behind the assumed relationship between the physical, psychosocial and organisational (i.e. safety) work environment and employee health. Furthermore, it has provided the theoretical basis for the relationships between the mentioned variables and self-reported involvement in occupational accidents. The overarching assumption made in this thesis was that factors, such as perception of the physical and psychosocial work environment and perceptions of the work safety climate, will influence the employees perceived level of health, well-being and the experience of occupational accidents at work. The main themes and the associations between them are presented in Figure 1.5.



*Figure 1.5 Main themes covered in the thesis and the relationship between them.*

The next section will present the methodological aspects applied to investigate the work and health relationships discussed in the four papers that are included in this thesis.

## 2 Methods

### ***2.1 Central themes of the studies***

The central aim of the presented work was a closer investigation of the separate parts of the composite health, safety and environment (HSE) culture/climate concepts in the Norwegian oil and gas industry. More specifically, the objectives were to examine employee health perceptions relative to perceptions of the work environment (i.e. the physical and psychosocial) and perceptions of the work safety climate. The present thesis also investigated the relationship between health, safety and work environment relative to employee self-reported involvement in occupational accidents. These aims resulted in four studies performed among different groups of workers in the Norwegian oil and gas industry.

The theoretical bases and the central concepts used in this thesis are introduced in the first section. The central concepts and the theoretical and empirical background to which they are related were investigated in the included papers using different samples of employees in different work environments (i.e. onshore and offshore), and also based on offshore employees with different job types and at different points in time (i.e. between 2001 and 2006). An overview of the general themes, covered in the four studies is presented in Figure 2.1.

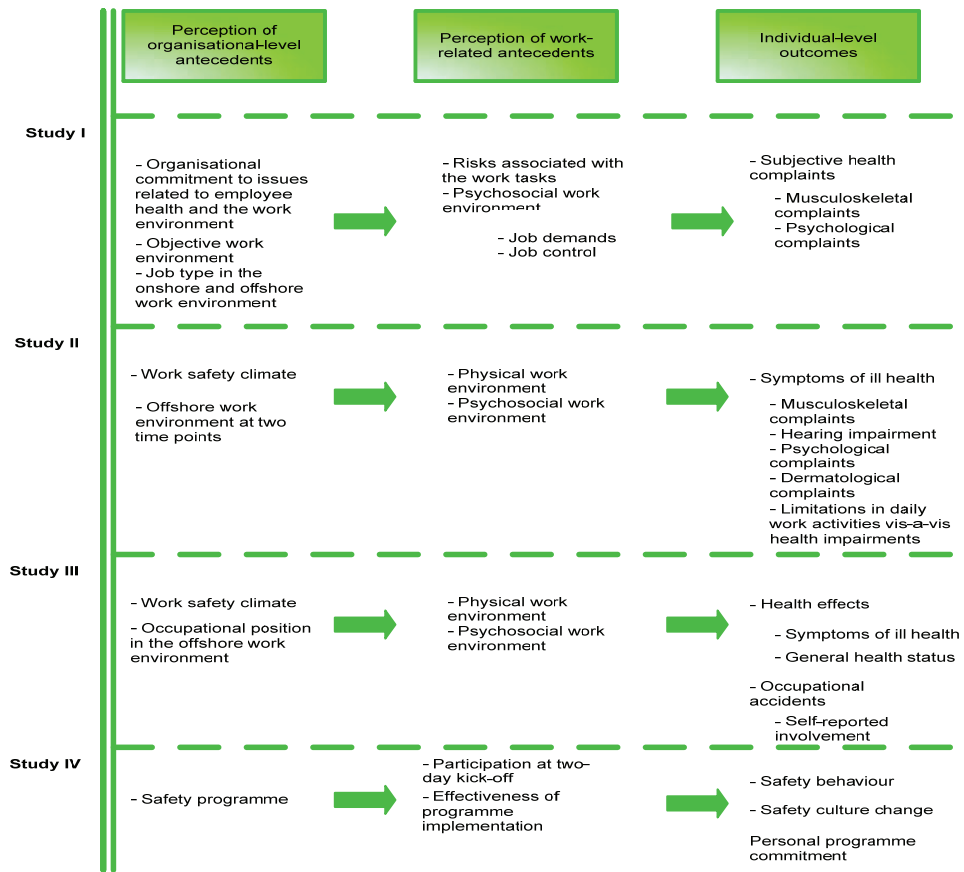


Figure 2.1 Overview of the central themes as covered in the four studies of the thesis.

## 2.2 Design, sampling and samples

The overall research design including the four papers in the thesis is based on cross-sectional survey designs. Additionally, in a parallel task, some semi-structured interviews with safety personnel representatives were conducted to further explore the HSE-concept. The interviews sought to gain a qualitative perspective on challenges and difficulties associated with HSE-culture/climate in the Norwegian oil and gas industry. These interviews are not part of the papers of the present thesis; nevertheless, they inspired the discussion concerning HSE culture/climate. A short description of and the results from these interviews are therefore included in Appendix V. Different samples were used in the four papers of this thesis, and a brief overview of the samples is provided in Figure 2.2.

Paper I	Paper II	Paper III	Paper IV
"Work and health – a comparison between Norwegian onshore and offshore oil and gas employees"	"Safety, health and work environment – a study of employees in the Norwegian oil industry"	"Health, environment, safety culture and climate – analysing the relationships to occupational accidents"	"Modelling the effects of a large-scale safety culture programme: a combined qualitative and quantitative approach"
Cross-sectional survey design	Cross-sectional survey design	Cross-sectional survey design	Combined qualitative and quantitative approach
Sample including onshore and offshore employees from a large multinational contractor company. The survey was conducted in the maintenance and modification division, which has commissions on the Norwegian continental shelf and internationally. Data were collected in 2004	Sample including offshore oil personnel. The survey was designed, and the data collected by the Norwegian Petroleum Safety Authority as part of the "Trends in Risk Level – Norwegian continental shelf" project. Data from 2001 and 2003 were used as part of the paper	Sample including offshore oil personnel. The survey was designed and the data collected by the Norwegian Petroleum Safety Authority as part of the "Trends in Risk Level – Norwegian continental shelf" project. Data from 2005/2006 were used as a part of the paper	Interviews and fieldwork were conducted on three offshore installations, one onshore gas plant, and different office departments within the selected organisation. A survey was carried out on seven offshore installations, one gas plant, and six onshore units. Focus discussion groups were employed immediately after the first and the second two-day kickoff gathering implemented in the organisation

*Figure 2.2 An overview of the different samples and the research design used in paper I, II, III and IV.*

The sample used in paper I included employees who divided their time between onshore and offshore work in a large contractor company, which is situated on the west coast of Norway performing maintenance and modification commissions on the Norwegian shelf and internationally. The two samples of offshore workers used in paper II were collected by the Norwegian PSA as part of the "Trends in Risk Level – Norwegian Continental Shelf" (TRL) project. Paper II included two sets of survey data collected in 2001 and 2003. The sample used in paper III was also collected by the PSA through the TRL project, and the data used were collected in 2005/2006. Paper IV used data collected in a large Norwegian petroleum company and included both qualitative and quantitative data. The qualitative data were collected at three offshore installations, one onshore gas plant, and at different office departments in the participating organisation. The quantitative data were collected at seven offshore installations, one onshore gas plant, and six onshore units.

## **2.3 Data collection and samples in the four papers of the thesis**

### **2.3.1 Paper I**

The survey that constitutes the basis for paper I was conducted in May 2004, using a self-completion questionnaire. The data collection was anchored in the maintenance and modification division of the participating organisation. This organisation employed approximately 5000 people at the time of the survey, 3,500 of whom worked in different departments in Norway. The main activity for the maintenance and modification division was

directed towards the oil and gas industry, and at the time of the study it had contracts on 43 of the 64 installations operative on the Norwegian Continental Shelf (NCS). The final sample used in paper I included both onshore and offshore workers.

The questionnaire was distributed to the onshore employees with the help of the personnel safety representative, and the data were collected during one week at the work setting. The researcher was present during the time of the onshore data collection and the employees handed in their questionnaires to the researcher in sealed envelopes. Address lists of offshore personnel were received from the HSE department in the company, and the questionnaire was mailed to the home address of the offshore employees. The offshore employees received the questionnaire together with a cover letter explaining the purpose of the study. This letter also informed the respondents that participation was voluntary and also that all the data collected would be treated confidentially according to the rules stated by the Data Inspectorate in Norway. In addition, a postage-paid envelope was included to send the questionnaire, free of charge, back to the University of Oslo. Responses from the offshore employees were received during one month. Due to the financial status of the project, no reminder letters were sent out to the offshore sample attempting to increase the response rate. Hence, there are different response rates between the samples.

A total of 878 questionnaires were distributed, and the total response rate in paper I was calculated to 47.1% with a sample of  $N=414$ . These respondents worked primarily (more than 75% of the time) onshore ( $N=290$ , 70%) or offshore ( $N=90$ , 21.7%). A small fraction of the employees divided their time between these two locations ( $N=25$ , 6.0%). The employees who divided their time between onshore and offshore work were included in the offshore group. The response rate for the onshore sample was calculated as 50.2%, and for the offshore sample it was calculated as 30% (see Table 2.1). The majorities in both samples were male and the average ages were 40 ( $SD=10.30$ ) and 42 ( $SD=10.13$ ) years, respectively. The onshore personnel reported that they worked for an average of 40 hours during one working week ( $SD=22.47$ ), while in the offshore sample the average working week was reported to be 60 hours ( $SD=27.27$ ). In both the onshore and the offshore work environments, eight job types were identified. Table 2.1 shows the percentage of workers in the onshore and offshore work environments by occupational position, i.e. work group.

*Table 2.1 Occupational groups in the overall sample and in the onshore and offshore work groups. Percentage and total number of respondents*

	Overall		Onshore		Offshore	
<b>Response rate</b>	<b>47.1</b>		<b>50.2</b>		<b>30.0</b>	
	N	%	N	%	N	%
Pipe workers	72	17.4	46	15.9	24	20.9
Steel workers	94	22.7	62	21.4	30	26.1
Electro and instrument workers	27	6.5	23	7.9	4	3.5
Engineers	63	15.2	59	20.3	4	3.5
Mechanical workers	45	10.9	20	6.9	24	20.9
Service workers	27	6.5	22	7.6	5	4.3
Administrative workers	51	12.3	38	13.1	13	11.3
Other	20	4.8	9	3.1	11	9.6
Missing	15	3.6	11	3.8	0	0.0
Total	414	100	290	100	115	100

As seen in Table 2.1, the largest work groups in the onshore sample consisted of steel workers (21.4%) and engineers (20.3%). In the offshore sample the largest part of the employees worked as steel workers (26.1%), mechanical workers (20.9%), and pipe workers (20.9%).

### 2.3.2 Paper II

The samples used in paper II were collected during two time intervals in 2001 and 2003 as part of the TRL project (PSA, 2000). The TRL project conducts a questionnaire survey biannually to track changes and variations in the employees' perceptions of, and attitudes to, the HSE situation on the NCS. Initially, the PSA decided that the questionnaire should be distributed to every employee arriving at operative installations on the NCS during a pre-specified time period (i.e. in 2001 and 2003). The population of interest was defined by the PSA as "all individuals employed on Norwegian offshore installations", and the two resulting samples used in paper II consisted of workers employed on different installations and within different companies' operative on the NCS.

#### 2.3.2.1 Data collection and sample in 2001

In 2001, the data collection was conducted between 10 December 2001 and 20 December 2001. The questionnaires were distributed to the workers with help of the medical staff onboard the installations. Along with the package of questionnaires, a cover letter was sent to the medical staff with instructions concerning the distribution and collection of the questionnaires. The specific number of questionnaires to be distributed was calculated on the basis of the average number of working hours conducted in the offshore industry during the specific time period as well as listings of operative installations, as received from the PSA

(PSA, 2001). A total of 6700<sup>3</sup> questionnaires were distributed to 64 operative installations on the NCS (PSA, 2001). During the 11-day data collection period it was assumed that most installations had implemented a complete crew change. The PSA states that the resulting sample comprised approximately a third of the work population, described as all individuals' travelling offshore during the specified time period (PSA, 2001). The questionnaires were not distributed to non-Norwegian speaking workers. The respondents could choose to return the completed questionnaire in a sealed envelope to the medical staff onboard the installation or to send it by post when arriving onshore (in a postage-paid envelope). When the data collection ended, 3310 respondents had completed the questionnaire (the approximate response rate as estimated by the PSA was 49%)<sup>4</sup>. The exact response rate from the 2001 survey is not known, since neither the exact number of workers employed nor the exact number of the questionnaires distributed is known. A few installations also asked for additional questionnaires, but it is not recorded how many additional forms were distributed. Furthermore, in some instances the medical staff reported that not all the received questionnaires were distributed due to e.g. an English-speaking crew.

The majority of the respondents in the 2001 sample were male (90.5%). The largest part of the workers was between 41 and 50 years of age (33%).<sup>5</sup> They had been working within the industry between 11 and 20 years (31.3% of the sample), and they held a permanent position offshore (82.1%). In 2001, 76.8% of the respondents worked at a fixed oil-producing installation, while 22.9% worked at a mobile/floating production unit. The workers were also asked to report in which work area they primarily performed their work, and seven such categories were provided in the questionnaire. The different work groups and the number and percentage of respondents within each specific group are shown in Table 2.2.

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<sup>3</sup> The number of questionnaires distributed was based on numbers from the Norwegian Petroleum Directorate based on average numbers of work hours conducted. Numbers from their databases indicated that 6400 employees would arrive at Norwegian offshore oil installations during the time period 10.12.2001 until 21.12.2001. In addition, information from the helicopter companies that shuttle employees to the shelf showed that 7502 passengers had travelled offshore during the mentioned time period.

<sup>4</sup> The actual response rates of the 2001 and 2003 surveys are estimated because the exact sizes of the populations are unknown. The Petroleum Safety Authority (PSA) does not have an exact overview of the actual number of employees working offshore. Instead they keep track of the average number of working hours conducted during one year. One man-labour year offshore is 1588 hours. In 2001, 32 119 286 hours were conducted within the industry; in 2003 the number of hours was 32 242 069. Note that these numbers also include overtime work.

<sup>5</sup> Age was coded in categories in the questionnaire used, and the following categories were provided: 1) under 20, 2) 21–30, 3) 31–40, 4) 41–50, 5) 51–60, 6) over 60 years.



*Table 2.2 Work groups used in 2001, the number of respondents and the percentage within each group*

<b>Work group</b>	<b>Number</b>	<b>Percentage</b>
Process workers	523	15.8
Drilling personnel	762	23.0
Well-services personnel	205	6.2
Accommodation personnel	319	9.6
Construction/modification personnel	215	6.5
Maintenance personnel	904	27.3
Other personnel	333	10.1
Missing data	49	1.5
<b>Total sample</b>	<b>3310</b>	<b>100</b>

The largest group of workers in the 2001 sample consisted of maintenance personnel (27.3%), followed by drilling personnel (23.0%), while the smallest group of workers consisted of employees in the work group well-services (6.2%).

### **2.3.2.2 Data collection and sample in 2003**

In 2003 the data were collected during the time period from 18 December 2002 to 18 January 2003. The population was again defined as all the personnel employed on Norwegian offshore oil installations (PSA, 2003). The questionnaires were distributed to all the heliports that shuttle employees to the offshore installations, and were collected with the help of the medical staff onboard the platforms (PSA, 2003). The respondents received the questionnaire on their departure from the heliport, and were encouraged to participate in the survey and either hand it in a sealed envelope to the medical staff onboard or, alternatively, to send it by post when arriving onshore (i.e. in a postage-paid envelope). The medical personnel at the different platforms were informed of the survey by their employer and they were responsible for returning the completed questionnaires to TNV Gallup. As in 2001, it was again unclear how large the actual population and sample in question was. A total of 20,200 questionnaires were distributed,<sup>6</sup> and 8567 of these were completed (the approximate response rate as estimated by the PSA was 50%). In 2003 the questionnaire was also available to English-speaking workers, and 197 workers (2.3%) completed the questionnaire in English.

The majority of the workers in the 2003 sample were male (approximately 90 %). The largest part of the employees reported themselves to be within the age category ranging from 41 to 50

<sup>6</sup> Information from the two helicopter companies shuttling employees to the Norwegian continental shelf shows that 23 000 passengers had travelled offshore within the time period from 18 December 2003 to 18 January 2004. However, included in this number are also personnel travelling to and from the installations more than one time during the mentioned time period.

(33.9%)<sup>7</sup> years of age followed by employees between 31 and 40 (30.7%) years of age. The largest part of the sample had been working in the industry between 11 and 20 years, and held a permanent position offshore. The majority of the workers reported that they worked at a fixed oil-producing installation (79%), while 19.6% reported working at a floating/mobile production unit. As in 2001, the 2003 respondents were asked to indicate their dominant area of work. The questionnaire provided the employees with eight different alternatives. Numbers and percentages within each work group are displayed in Table 2.3.

*Table 2.3 Reported work groups in the 2003 sample, number of employees along with percentages*

<b>Work group</b>	<b>N</b>	<b>Percentage</b>
Process workers	1108	12.9
Drilling personnel	1480	17.3
Well-services personnel	589	6.9
Accommodation personnel	733	8.6
Construction/modification personnel	542	6.3
Maintenance personnel	2272	26.5
Crane/deck personnel	483	5.6
Other	741	8.6
Missing	619	7.2
<b>Total sample</b>	<b>8567</b>	<b>100</b>

The table shows that the largest part of the workers consisted of maintenance personnel (26.5%) followed by drilling personnel (17.3%). The smallest work group in the 2003 sample consisted of crane/deck personnel (5.6%), construction and modification personnel (6.3%), and personnel employed within well services (6.9%).

### **2.3.2.3 The 2001 and 2003 sample**

The data collection period was extended from two weeks in 2001 to six weeks in 2003, and the samples varied considerably in size (PSA, 2003). However, both samples were considered to be representative of the population of offshore workers in 2001 and 2003 by the Norwegian Petroleum Safety Authority (PSA, 2001; PSA, 2003). According to the PSA, the distribution of responses for different personnel categories corresponded closely to information received from other sources on the number of working hours produced in the two time periods and other demographic information (e.g. gender, age) (PSA, 2003).

<sup>7</sup> Age was measured as a categorical variable in the questionnaire. The following categories were provided: 1) under 20, 2) 21–30, 3) 31–40, 4) 41–50, 5) 51–60, 6) over 60 years of age.

### 2.3.3 Paper III

The data used in paper III were collected by the Norwegian PSA through the TRL project, and were made available to the author in 2006. The data collection period lasted from 20 December 2005 until 13 March 2006, and the respondents consisted of Norwegian offshore oil workers travelling offshore during the specified time period. It was estimated that all the employees working on the NCS would have been at work at least once during this time period (PSA, 2006). The PSA reported some difficulties with regard to the data collection: some installations had ordered double consignments, and some questionnaires had “gone astray” and hence needed to be sent out again (PSA, 2006). However, it is not recorded how large the magnitude of these problems were.

The questionnaires were distributed to all the installations owned by different operating companies on the NCS, either with the help of a contact person in the operator company or through the heliports that shuttle employees to the shelf (PSA, 2006). A total of 27,739 questionnaires were distributed during the data collection period. The employees were encouraged to complete the questionnaire during working hours and to return it, either to the medical staff onboard the installation or in a sealed box on the installation. The respondents could also choose to complete the questionnaire on the Internet or to send it directly to Sentio<sup>8</sup> in a postage-paid envelope when arriving onshore. When the data collection ended, 9945 respondents had completed it. According to the PSA, this corresponds to a response rate of approximately 50%<sup>9</sup>. The response rate was estimated on the basis of the number of working hours during the aforementioned data collection period. It is important to note, however, that the number of working hours does not necessarily correspond to the exact number of people who worked on the shelf during this time period. This is because the number of working hours also includes part-time employees, overtime work etc. An estimated response rate of 50% was considered satisfactory by the PSA (PSA, 2008).

The majority of the 9945 respondents in the sample were male (89.5%), most often between 41 and 50 years (34.6%) and between 31 and 40 years of age<sup>10</sup> (32.5%), and most worked in a

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<sup>8</sup> Sentio had the overarching responsibility for the registration and the scanning of the questionnaires that were received as part of the TRL project.

<sup>9</sup> According to the PSA, the estimated response rate was calculated as 50%. However, based on the number of distributed questionnaires in the “Trends in Risk Level” report (2006), the response rate would be 35.8%. It is not possible to estimate the response rate in greater detail due to little reporting of the handling of the questionnaires. Some installations had ordered double the amount of questionnaires and some shipments of the questionnaire had gone astray, moreover, the number of “missing” questionnaires was not recorded.

<sup>10</sup> Age was measured by six categories, 1) under 20, 2) 21–30, 3) 31–40, 4) 41–50, 5) 51–60, 6) over 60 years.

permanent position offshore (90.9%). The largest part of the sample had more than 10 years of experience in their work. The majority of the sample (73.5%) reported that they worked at a fixed oil-production installation, while 26.5% worked at a mobile/floating production unit. Also, 81.3% of the sample worked a permanent shift rotation offshore, and the most normal working time arrangement being day shift (42%) followed by a shift rotation of 14 nights *or* 14 days during one trip offshore (15.2%). The respondents were also asked to indicate their occupational work group for which eight response alternatives were provided. Table 2.4 shows the number and the percentage of workers within each work group.

*Table 2.4 Reported work groups in the 2005/2006 sample, the number of employees along with percentages*

<b>Work group</b>	<b>N</b>	<b>Percentage</b>
Process workers	1221	12.3
Drilling personnel	1888	19.0
Well-services personnel	578	5.8
Accommodation personnel	848	8.5
Construction/modification personnel	583	5.9
Maintenance personnel	2611	26.3
Crane/deck personnel	623	6.3
Other	900	9.0
Missing	693	7.0
<b>Total sample</b>	<b>9945</b>	<b>100</b>

Table 2.4 shows that the largest work group consisted of maintenance personnel (26.3%) followed by drilling personnel (19.0%) and process workers (12.3%).

### 2.3.4 Paper IV<sup>11</sup>

The data<sup>12</sup> used in paper IV consisted of qualitative interviews<sup>13</sup> and fieldwork observations as well as a questionnaire study. The data were collected in an operator company on the NCS to investigate the effects of a comprehensive safety programme in different departments and work areas.

<sup>11</sup> Paper IV is written as a collaborative effort between Espen Olsen (first author, and responsible for the data collection), Anne Mette Bjerkan (second author), and Thor-Olav Nævestad (third author). The second and the third authors contributed equally in the preparation of the manuscript.

<sup>12</sup> Espen Olsen and Tor-Olav Nævestad were responsible for the data collections in paper IV.

<sup>13</sup> The qualitative interviews and the fieldwork in paper IV were conducted by Tor-Olav Nævestad at the Centre for Technology, Innovation and Culture at the University of Oslo.

#### **2.3.4.1 Sample collected through qualitative methods**

Semi-structured interviews (N=151) were conducted onboard three offshore oil installations, one onshore gas plant, and in different office departments in the enterprise. Management and employees representing both contractor companies and the operator company at each workplace were interviewed. The interview sample also included safety deputies and employees representing labour organisations.

Fieldwork observations were also used as part of paper IV. The fieldwork was conducted onboard three offshore installations, one onshore gas plant, and two other onshore units, and lasted about six days at each place. The fieldwork consisted of stays and observations in the departments of operator and contractor staff. Field notes were written for each work unit and key personnel in the enterprise evaluated the soundness of these notes. This approach was adopted to assess the dynamics related to the individual and work characteristics, which again was related to the implementation and the effect of the safety programme.

#### **2.3.4.2 The sample collected through the quantitative approach**

A questionnaire survey was developed and conducted on seven offshore oil installations, one onshore gas plant, and six other onshore units (N=1221). The response rate was calculated as 40%. The sample was considered to be representative of the participating organisation based on the following sample characteristics: 76.6% of the respondents worked on offshore installations, 19% had management responsibility, 86.7% had participated in the two-day safety programme kick-off gathering, 34.5% were employed in a contractor company, and 58.3% were at least 40 years old.<sup>14</sup>

### **2.4 Measures applied in the papers**

The following section provides a description of the applied measures in the four papers of the thesis. The objectives and results reported in the different papers build upon different measures, all of which are based on existing theory and empirical work from the occupational health literature, literature regarding risk perception, and organisational culture/climate (safety culture/climate) research fields.

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<sup>14</sup> For a more comprehensive account of the methodology applied in paper IV, see Olsen, E. (2009). Safety climate and safety culture in health care and the petroleum industry: Psychometric quality, longitudinal change and structural models. PhD thesis, Faculty of Social Sciences, University of Stavanger.

### **2.4.1 Measures applied in paper I<sup>15</sup>**

The questionnaire used in paper I was organized in 20 sections, including demographic characteristics; in total 199 items. The topics and items chosen for paper I were selected on the basis of relevance vis-à-vis theoretical approach and previous empirical findings, and due to their potential importance for examining health and well-being in the work context. The questionnaire consisted of measures from the General Nordic Questionnaire (QPS-Nordic), e.g. job demands, perceived control, social support, and organisational climate (Dallner et al., 2000). The application of the QPS-Nordic is associated with several advantages. First, the scales used are thought to be “value free”, implying that the questions are not framed in a particular way, i.e. positive or negative. The respondents are asked to evaluate the different items on response scales ranging from “very seldom or never” to “very often or always”. Furthermore, the scales included from the QPS-Nordic measuring instrument have been validated in four Nordic countries (Dallner et al., 2000), thereby suggesting that the items included tap into several areas of importance for employee’s social and psychological well-being in a more general work context.

Specific items were also chosen from the Subjective Health Complaints Inventory (Eriksen, Ihlebaek, & Ursin, 1999). Additionally, items were included that concerned how the respondents perceived risks associated with the work tasks, external influences on work performance, perception of the quality of the information received from the company, as well as perception of the organisation’s commitment to and work with issues related to employee health and the work environment. The latter four scales were developed by the author. Six sections from the questionnaire were used as part of paper I, i.e. subjective health complaints, job demands, perceived control, perceived risks associated with the work tasks, external influences on work performance, and perception of the organisation’s commitment to and work with issues related to employee health and the work environment. These aspects were investigated in relation to the actual work environment, i.e. whether the employees worked primarily (more than 75%) onshore or offshore. The scales and measures applied in paper I are described in the following sections.

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<sup>15</sup> The measures/questionnaire used in paper I are shown in appendix I. The questionnaire used in paper I was only available in Norwegian.

### 2.4.1.1 Onshore and offshore work

Two variables measured the amount of time the employees spent at the onshore and offshore work locations during the last 12 months prior to the study. The employees were asked, given the following response categories, to describe their *dominant* place of work onshore or offshore, respectively: 1) 100–75%, 2) 74–50%, 3) 49–25%, and 4) 24–0%. Based on the two variables (i.e. onshore and offshore work), a new variable was constructed for classification purposes, named *objective work environment*. It consisted initially of three levels i.e. primarily onshore, equal amounts of time spent onshore and offshore, and primarily offshore. Only 25 (6%) respondents reported that they spent equal amounts of time in the onshore and offshore work environments. These workers were included in the offshore category due to the assumption that these employees must meet the same medical standards as required for offshore work (see Table 2.5).

*Table 2.5 Categorisation of dominant workplace based on the objective work environment variable. Number of employees and percentages of work time spent at the two locations*

Dominant workplace	N	Percentage
<b>Primarily onshore</b>	<b>290</b>	<b>70.0</b>
<b>Primarily offshore</b>	<b>115</b>	<b>27.8</b>
<b>Missing</b>	<b>9</b>	<b>2.2</b>
<b>Total sample</b>	<b>414</b>	<b>100</b>

### 2.4.1.2 Job type in the onshore and offshore work environments

The employees' types of job in the onshore and offshore work environments were used in paper I as the basis to examine differences in health perceptions. Eight job types were identified in both work environments. These were: 1) pipe workers, 2) steel workers, 3) electro and instrument workers, 4) engineers, 5) mechanical workers, 6) service workers, 7) administrative workers and 8) other (see Table 2.1).

### 2.4.1.3 Subjective health status

The employees' perception of their own health status was examined using selected items from the Subjective Health Complaints Inventory (SHI). The items were selected from the "musculoskeletal complaints" dimension and the "pseudo-neurology" dimension to measure the physical and the psychological aspects of employee health. The respondents were asked to provide answers regarding both intensity<sup>16</sup> (four-point scale) and duration (i.e. number of

<sup>16</sup> Scale subjective health complaints: 1=not at all affected, 2=a little affected, 3=somewhat affected, 4=seriously affected.

days) for each complaint during the previous thirty days. Examples of the health complaints included were shoulder pain, neck pain, anxiety, sadness/depression, tiredness, and dizziness.

Eight items measured musculoskeletal pains (e.g. headaches, lower back pain, and neck pain) and seven items measured “pseudo-neurology” (e.g. sleep problems, dizziness, and sadness/depression). These items were collapsed into two dimensions measuring the physical and psychological aspects of employee health, respectively. The results showed satisfying internal reliability results (0.766 and 0.725, respectively). These two dimensions were also assessed by a confirmatory factor analysis. Results from this analysis were considered satisfactory (Satorra-Bentler  $\chi^2=214.8$ ,  $df=89$ , RMSEA=0.059, NFI=0.963, NNFI=0.974, CFI=0.978).

#### 2.4.1.4 Perception of job demands

Perceptions of job demands were investigated using the job demands scale drawn from the QPS-Nordic<sup>17</sup> (Dallner et al., 2000). It included 22 questions related to the social and psychological work environment. Examples of questions are: “Is your work load irregular so that work piles up?”, “Do you consider your work meaningful?”, and “Do you have to repeat the same work procedures at intervals of a few minutes?” The respondents answered the questions on five-point scales, ranging from 1=seldom or never to 5=often or always, in terms of how applicable the items were to their work situation.

Based on a principal component analysis, four latent dimensions of job demands were identified. These dimensions were named: 1) “pressure at work” ( $\alpha=0.794$ ), 2) “challenges at work” ( $\alpha=0.679$ ), 3), “repetitive work” ( $\alpha=0.655$ ), and 4) “cost of errors” ( $\alpha=0.667$ ).

#### 2.4.1.5 Perception of control

The items measuring perception of control at work were drawn from the QPS-Nordic (Dallner et al., 2000). The index included nine items, evaluated on five-point scales ranging from 1=to a very little extent to 5=to a very large extent. Two factors previously reported by the QPS-

<sup>17</sup> The authors constructing the QPS-Nordic used 22 items as a basis for extracting three dimensions measuring job demands. These were named *quantitative demands*, *decisional demands*, and, *learning demands* (Dallner et al., 2000). Additionally they extracted a fourth factor named *positive challenges at work*, from the 22 items as a measure of perception of control at work. However, this fourth factor was actually drawn from the job demands scale, and not from the control scale which is also a part of the QPS-Nordic. Hence, four factors in the QPS-Nordic were drawn from the items intending to measure job demands. In paper I tests of the internal reliability gave sub-optimal results and hence failed to reproduce the factor structure as previously reported by the QPS-Nordic. New principal component analyses were therefore conducted to identify the latent dimensions descriptive of job demands.



Nordic constructors were assessed by means of a confirmatory factor analysis. The factor structure previously reported fitted the data at hand satisfactorily: Satorra–Bentler  $\chi^2=57.5$ ,  $df=21$ , RMSEA=0.065, NFI=0.962, NNFI=0.958, CFI=0.975.

The first factor was called “control of work pacing” ( $\alpha=0.643$ ), and the second factor was named “control of decision” ( $\alpha=0.648$ ). In paper I it was decided, based on the fit statistics and on the calculated reliability of the extracted dimensions, to use the two dimensions measuring control at work previously been reported in the QPS-Nordic instrument (Dallner et al., 2000).

#### **2.4.1.6 Perceived threats associated with the work tasks**

Nine statements measured the employees’ perception of threats associated with work tasks. These items were constructed by the author based on previous empirical findings in the oil and gas industry, which have identified common sources of stress inherent in the working environment. The items were measured on five-point Likert-type scales, ranging from 1=strongly agree to 5=strongly disagree. The items were threats associated with chemical agents, exposure to air pollution and dust, noise, the risks associated with working with dangerous tools and machinery, and working in awkward positions for significant periods of time. The employees judged the items with regard to the relevancy to their own work tasks. A principal component analysis with Varimax rotation, using the Kaiser’s criterion and a scree plot, showed that the nine items loaded on one dimension ( $\alpha=0.902$ ), and hence one dimension was used to account for the employees’ perception of threats associated with the work tasks in paper I.

#### **2.4.1.7 External influences on work performance**

External influences on the work performance were measured using eight items. The respondents were asked to indicate how each condition applied to and affected their work performance. The eight included items were constructed by the author and based on the research literature, which has identified problematic aspects of working in the oil and gas industry. Examples of included statements are: “You do not have the time to do your job properly”, “Time is more important than safety”, “You have to work overtime”, and “You are far away from family and friends while offshore”. External influences on perceived work performance were measured on five-point scales ranging from 1=to a very little extent to 5=to a very large extent.

Two latent dimensions were identified through a principal component analysis that divided the eight items into groups of five and three items, respectively. Dimension 1 was named “uncontrollable events” ( $\alpha=0.690$ ) and the second dimension was called “family-job balance” ( $\alpha=0.455$ ). The second dimension showed less than satisfactory internal reliability results. However, it was assumed that the balance between family and job would contribute to the employee’s perception of health in the work context, and it was deemed important not to exclude the items from further analyses. The items comprising the dimension of “family-job balance” were therefore used as single items in the analyses of paper I.

#### **2.4.1.8 Perception of organisational commitment to issues related to employee health and the work environment**

In the questionnaire, fifteen items measured how the respondents perceived the organisation’s commitment to, and work with, issues related to employee health and the work environment. They were developed by the author. Included items were e.g. “The company does not care about employee health as long as the job gets done”, “I know how to take care of my own health at work”, and “Problems related to employee health and the work environment are frequently discussed in the company”.

The employees were asked to indicate how strongly they agreed or disagreed with the content of each statement on five-point scales ranging from 1=completely agree to 5=completely disagree. The 15 items were organised into four dimensions, and these were named “organisational commitment to employee health” ( $\alpha=0.834$ ), “organisational commitment to the work environment” ( $\alpha=0.653$ ), “perception of organisational responsibility for employee health and the work environment” ( $\alpha=0.840$ ), and “individual responsibility” ( $\alpha=0.504$ ). The internal reliability of dimension four was unsatisfactory, and therefore these items were used as single items in the analyses in paper I.

#### **2.4.2 Methodological concerns in paper I**

A methodological problem associated with the results reported in paper I needs to be specifically highlighted. It concerns the relatively low response rate, particularly among the offshore workers (response rate approximately 30%). The possibility of systematic differences between respondents and non-respondents cannot be excluded, and this could ultimately damage the validity of the results reported. The problem with the low response rate raises the question of whether the results can be generalised to the population in question (i.e. onshore and offshore maintenance and modification workers). In order to answer this question it is of

importance both to state the aim of the study and to specify the target population clearly. The objective of paper I was to examine the relationship between social, psychological, and organisational work factors and self-reported health, and to examine differences in work and health perceptions among onshore and offshore workers.

The participating respondents performed maintenance and modification commissions within the oil and gas industry both onshore and offshore. The implication is that the results reported in paper I cannot be used to draw general conclusions about the oil and gas population at large, but should be related to how certain groups of employees working in a contractor company perceived aspects of their work environment and self-reported health status. Furthermore, great care was taken in scale development, i.e. with regard to content validity, which concerns the extent to which a specific set of items reflects a theoretical domain or actually measures what it intends to measure (DeVillis, 2003). Also, the validity of the results reported in paper I is strengthened because they are in accordance with other studies comparing onshore and offshore workers. It should also be noted that the low response rate among the offshore workers in paper I was heavily influenced by the circumstance that a large group of selected respondents never received the questionnaire. Additionally, there was no reminder sent to those who received the questionnaire by post, due to financial reasons in the project.

### **2.4.3 Reliability and validity of the measures used in papers II and III**

The samples used in papers II and III were collected through the TRL project. The same questionnaire, with some modifications, was used at three points in time (i.e. 2001, 2003 and 2005/2006). The main purpose of these studies was to describe how Norwegian offshore oil workers perceive the work related to the health, safety, and environment (HSE) within the oil and gas industry. Furthermore, the questionnaires aimed at describing which factors contribute to the perception of HSE at work (PSA, 2000; PSA, 2001; PSA, 2003; PSA, 2006). To achieve the objectives set by the PSA, a representative sample of Norwegian offshore oil workers was drawn at three points in time, from a population defined as “all employees travelling to the shelf during the specific time periods in question” (PSA, 2000).

Important issues regarding the used data concern the reliability and validity of results from questionnaire studies. All the measures that were applied in papers II and III from the TRL questionnaire showed acceptable internal reliability coefficients as calculated by Cronbach's alpha. In paper II the indices extracted were also tested, or confirmed, in a second sample,

which strengthens the reliability of those measures, i.e. the stability of the measures used serves as an indicator of their *construct* validity. The construct validity refers to the degree to which inferences can legitimately be made from the operationalisations in the study to the theoretical constructs on which those operationalisations were based, such as the employees' perception of the work safety climate and the work environment.

Validity could be discussed as a problem with respect to the measurement of the work safety climate, utilised both in paper II and in paper III. There has been an abundance of research regarding the safety culture/climate concept, as was mentioned in the introductory section, but no consensus has been reached regarding which dimensions or facets this concept ought to, or must, include. This uncertainty influences the validity of the overarching concept of safety culture/climate. However, research has highlighted some common aspects or themes of importance for employee health and well-being at work and in the research literature concerning the work safety culture/climate. These themes were assumed to be included in the TRL questionnaire and they are therefore used in paper II and III, thereby strengthening the validity of the included concepts. It is also expected that a longitudinal approach, such as the one adopted in the TRL questionnaire, will contribute to increasing the generalisability and validity of the results reported in the present thesis.

The development of the TRL questionnaire was built on a qualitative pilot project to strengthen the validity of the concepts (PSA, 2000). Sixteen key informants in the industry were interviewed as part of the TRL pilot project to identify the risk indicators that ought to be included in a measurement instrument concerning HSE. Additionally, the informants were asked to make a quality assurance of a list of items on the basis of existing empirical research, as well as their experience with regard to risk and safety within the industry (PSA, 2000). This pilot project work was assumed to influence positively the content validity of the indices extracted from the TRL questionnaire.

Both specific and general problems have been discussed in the research concerning the TRL questionnaire. One specific problem associated with the TRL questionnaire has been the "confusion of terms". As previously stated, the main topic covered in this questionnaire concerns safety, although safety in the TRL questionnaire is measured under the heading of *HSE* (i.e. health, environment, and safety). Employee health in the questionnaire is measured by symptoms of ill health, and to measure the work environment aspects of the HSE concept, the items measuring "perception of the work situation offshore" are used. In the present thesis the items chosen to measure the HSE status offshore are: a) employees' perceptions of the

work safety climate. b) The work environment aspects are examined using employees' perceptions of the work situation offshore. c) The health aspect, as part of the composite HSE concept, is included in the present thesis with an investigation of reported symptoms of ill health as well as the employees' perception of their current general health status.

Another possible problem with the TRL questionnaire concerns the PSA objective of examining developments in the HSE status offshore over time (PSA, 2000). The questionnaire has been somewhat altered from the "original" one distributed in 2001. New items have been added and other items have been removed, making it difficult to reproduce the results from the 2001 survey. This procedure has made it more difficult to examine the validity of the changes in employee perceptions that have been reported since 2001 (e.g. that the risk level has decreased). An additional problem associated with the TRL questionnaire stems from the measurement scales used, particularly regarding the measurement of health (in paper II), perceived limitations in daily activities vis-à-vis health impairments while offshore (paper II), and the employees' self-reported involvement in occupational accidents (paper III). These aspects were measured on dichotomous scales (health in paper II and occupational accidents in paper III). The implication of these choices of measuring scales is that the resulting data do not follow a multivariate normality distribution. Therefore, great care was taken in both papers to correct for the lack of a multivariate distribution of the data by means of the methods of estimations and the analyses that were applied. These applied estimation methods will be reviewed below. The next section will give an overview of the central measures that were applied in paper II, with the mentioned methodological limitations in mind.

#### **2.4.4 Measures applied in paper II<sup>18</sup>**

The questionnaire used in 2001 comprised of five main sections and 26 sub-sections: in total 134 items. The first part of the questionnaire measured background variables (e.g. gender, age, and number of years in the work). The second part included 49 items and intended to measure perception of the work safety climate (e.g. communications about safety, management commitment to safety activities). Part three of the questionnaire measured the perception of risk while at work, such as the risk of experiencing a blowout and the risk of sabotage or terrorist acts. The fourth part measured aspects that were considered to be of importance for the work environment, such as physical (e.g. noise, lighting conditions) and psychosocial work environment factors (e.g. relationship with colleagues and immediate

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<sup>18</sup> The measures/questionnaire used in paper II is shown in Appendix II. The questionnaire utilised in the 2001 survey was only available in Norwegian. The questionnaire used in the 2003 survey was also available in English (see Appendix II).

supervisor). The fifth and final part of the questionnaire addressed subjective health complaints (e.g. musculoskeletal pains, allergies) and perceived limitations in daily activities offshore vis-à-vis the reported health impairments.

The questionnaire used in 2003 was structured in 32 sub-sections, including demographic variables, with a total of 157 items. The objectives of the 2003 survey were, as in 2001, to measure the employees' perception of HSE within the offshore oil and gas industry. A few changes had been made since the previous data collection, and the 2003 survey also included elements such as self-reported sleep deprivation and tiredness, as well as stress associated with the necessary helicopter travel to and from work. The following presentation provides an overview of the measures that were used in paper II. One objective in paper II was to examine differences between the 2001 and 2003 samples. For this reason, only the items and measurements used in both surveys are reviewed in the following sections. All the indices used in the analyses in paper II showed acceptable internal reliability.

#### **2.4.4.1 Subjective health**

Subjective health was measured by six symptoms in 2001, and eight in 2003. Six symptoms remained the same across the two surveys. These were: impaired hearing, musculoskeletal pains, dermatological problems, allergic reactions, cardiovascular diseases, and psychological complaints (e.g. depression and anxiety). The employees were asked to indicate whether or not they had experienced these symptoms during the three months prior to the surveys. Two response categories were specified: 1=yes and 2=no. The respondents were also presented with a single item regarding how they perceived their current general health status. The responses were measured on a five-point scale ranging from 1=very good to 5=very poor.

In addition to the specific symptoms of ill health and perceived general health status, the questionnaires in 2001 and 2003 measured the extent to which the employees perceived that their subjective health status impaired their daily work activities offshore. The tasks and activities that were rated included e.g. lifting heavy objects and working in the same position for extended periods of time. A three-point scale was used to evaluate these activities with the categories: 1=my health does not impair me, 2=my health impairs me to some extent, and 3=my health impairs me to a great extent.

#### **2.4.4.2 Perceptions of the work environment**

Six items measured the respondents' perception of the social and psychological work environment in 2001. The same items were used in 2003. Included were: the ability to plan one's own work, relationships with co-workers and relationships with the closest supervisor, possibilities to develop own skills, and the appreciation of one's work. In addition, one item measured the respondents' perception of the overall working environment. The questionnaires also included 15 items related to how the respondents perceived their physical working conditions offshore, e.g. noise, air quality, weather protection, lighting conditions, and the ergonomic design of the workplace. They were asked to evaluate the items concerning the , psychological and physical working conditions on five-point scales ranging from 1=very satisfied to 5=very dissatisfied.

Three dimensions were extracted to account for the respondents' perception of the work environment in paper II: "the physical work environment" ( $\alpha=0.823$ ), "the psychosocial work environment" ( $\alpha=0.816$ ), and "the perception of the work content" ( $\alpha=0.815$ ). These three dimensions accounted for 53% of the variance in the offshore employees' perceptions of the working environment.

#### **2.4.4.3 Perception of risk at work**

Perceived risk was measured with nine items in 2001 and 2003. The included items were: fires, gas leakages, exposure to toxic wastes/chemicals, blowouts, serious work accidents, sabotage/terrorist acts, breakdown in the installation's construction, collisions with ships and helicopter accidents (see Appendix II). The respondents were asked to indicate the degree to which they felt that each of the aspects constituted a threat to them while at work. They responded on six-point scales ranging from 1=little danger to 6=grave danger. The nine items measuring perceived risks at work grouped along two dimensions, i.e. "sources of risk in the working environment" ( $\alpha=0.847$ ) and "uncontrollable events" ( $\alpha=0.780$ ).

#### **2.4.4.4 Perception of the work safety climate**

Perception of the work safety climate was measured with 49 items in 2001. Some changes were made in the 2003 questionnaire but 46 items remained the same and were therefore included in the measurement of the work safety climate in paper II. Examples of included items were: "In practice, concern for production precedes the concern for safety", "I am not sure of my role in the emergency organisation", "I am occasionally required to work in a manner that jeopardizes safety", "The safety deputies' suggestions are taken seriously by the

management”, and “Safety has top priority when I do my job”. The 46 items were evaluated on five-point scales ranging from 1=completely agree to 5=completely disagree.

A principal component analysis with Varimax rotation was applied to the 46 work safety climate items. Kaiser’s criterion and the Scree plot suggested that six dimensions were the most descriptive. These dimensions were named: “lack of communication about safety” ( $\alpha=0.921$ ), “organisational commitment to safety work” ( $\alpha=0.832$ ), “dangerous tendencies” ( $\alpha=0.694$ ), “individual responsibility for safety at work” ( $\alpha=0.676$ ), “personal competence” ( $\alpha=0.534$ ), and “knowledge about safety” ( $\alpha=0.529$ ). The internal reliability coefficients were satisfactory, with the exception of dimension five and six (0.534 and 0.529, respectively). The four items comprising these two dimensions were therefore used as single items in further analyses in paper II.

#### **2.4.4.5 Employee age**

Employee age was thought to be of importance in paper II. Since the data used in paper II were drawn from two different samples, the age variable was included as a control factor in the analyses in order to examine differences between the 2001 and 2003 employees. The latent factors of work safety climate, perceived risk, subjective health, and perceptions of limitations in daily activities vis-à-vis health impairments were also estimated by using LISREL analyses where the effect of age was included. In the TRL questionnaire, age was measured as a categorical variable (i.e. in 2001 and 2003). The following categories were used: 1=under 20 years, 2=21–30 years, 3=31–40 years, 4=41–50 years, 5=51–60 years, and 6=61 years and older.

#### **2.4.5 Measures applied in paper III<sup>19</sup>**

The questionnaire used in paper III was organized into six main parts and 40 sub-sections, including demographic variables, with a total of 152 items. The purpose of the questionnaire was to describe how employees in the Norwegian offshore oil and gas industry perceived the HSE status. It also aimed at describing factors contributing to the perception of HSE, on the basis of a large sample of the offshore workforce (PSA, 2006).

The first part of the questionnaire asked for background variables (e.g. gender, age, years worked in the industry, and years worked in the current occupational position). The second

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<sup>19</sup> The measures/questionnaire used in paper III are shown in Appendix III. The questionnaire was available both in English and Norwegian. The English version is shown in the Appendix.



part consisted of 46 items measuring the perception of the work safety climate (i.e. aspects of the working situation and the perceived importance of health safety and the work environment), the third part measured the perception of risk concerning accidents at work, and the fourth part measured recreational opportunities while offshore (e.g. food quality and the quality of the living quarters). Questions regarding the physical and the psychosocial work environments were also included. Information about self-reported sickness absence and symptoms of ill health (e.g. musculoskeletal complaints and allergies) were provided by the respondents. The sixth and final part included items measuring the quality of sleep while offshore. A selection of these variables were used in paper III, i.e. those related to the perception of the work safety climate, the work environment, and the perception of subjective health status. These variables will be described in more detail in the following.

#### **2.4.5.1 Subjective health**

Subjective health was measured by 12 specific symptoms, i.e. impaired hearing, tinnitus, headaches, pains in neck/shoulder/arm, pains in back, pains in knees/hips, problems with vision, skin disorders (e.g. eczema, rash), allergic reactions, ailments of the respiratory tract, cardiovascular diseases, and psychological complaints (e.g. anxiety, depression, sadness, worry). The respondents were asked to indicate the extent to which they had been affected by each of these symptoms during the last three months. The response scale included the following alternatives: 1=not affected, 2=somewhat affected, 3=affected to some extent, and 4=severely affected. In addition, the respondents were asked to indicate whether they believed that the specific health complaints were a result of their working situation, choosing the response alternative 1=yes. The questionnaire also measured the employees' perception of their current general health status, and the respondents were asked to indicate their degree of satisfaction in this respect. This single item used a five-point scale ranging from 1=very good to 5=very poor.

In paper III, three dimensions were extracted to account for reported symptoms of ill health through principal component analysis, using Varimax rotation and by employing the Kaiser's criterion and the Scree plot. The dimensions were named: "musculoskeletal complaints" ( $\alpha=0.664$ ), "allergic reactions" ( $\alpha=0.662$ ), and "impaired hearing" ( $\alpha=0.670$ ). Additionally, the single item measuring general health status was included in the analyses in paper III.

#### **2.4.5.2 Perception of the working environment**

Perceptions of the social, psychological, and physical working environments were measured with 25 items in paper III. The included items concerned the working situation offshore and involved noise, skill utilisation, heavy lifting, and perceived challenges at work. Included were also aspects of the psychosocial work environment, such as the degree of perceived support from the closest supervisor and from co-workers. The employees were asked to evaluate the included items on five-point scales ranging from 1=very seldom to 5=very often.

Four dimensions were extracted, using a principal component analysis to account for the employees' perception of the offshore work environment. These dimensions were named: "the physical work environment" ( $\alpha=0.813$ ), "the supportive work environment" ( $\alpha=0.785$ ), "perceived control over work" ( $\alpha=0.680$ ), and "positive challenges at work" ( $\alpha=0.666$ ). These dimensions accounted for 57% of the variance in the employees' perceptions of the working environment. The internal reliability coefficients were satisfactory. Two single items were also used to account for the work environment in paper III. These items concerned the respondents' perception of working capacity related to the physical and psychosocial demands posed by work. The two items were evaluated on five point scales ranging from 1=very good to 5=very poor.

#### **2.4.5.3 Perception of the work safety climate**

The employees' perceptions of safety and risk at work were measured with 55 items in paper III. Out of these, 46 items concerned safety, while nine concerned perceived risk more specifically. Included in the measurement of the work safety climate were statements such as, "I sometimes violate safety rules to get the job done", "I have the necessary competence to conduct my work in a safe manner", and "My worksite is often untidy". The respondents evaluated these assertions on five-point scales ranging from 1=completely agree to 5=completely disagree. Perception of risk at work was measured with nine items, e.g. the risk of experiencing events such as fire, serious work accidents, and the risk of being exposed to toxic wastes or chemicals. The respondents were asked to indicate the degree to which they felt that the included hazardous events constituted a threat to them while at work on six-point scales ranging from 1=little danger to 6=grave danger.

From the 55 items intending to measure the work safety climate, five theoretical factors were constructed. The internal reliability was calculated using the Cronbach's alpha coefficient (Cronbach, 1951). The factors were constructed based on Flin and colleague's (2000) review

article, which identified common themes in the safety culture/climate literature (Flin et al., 2000). The five identified factors measuring work safety climate were named: “management” ( $\alpha=0.782$ ), “safety system” ( $\alpha=0.782$ ), “risk perception” ( $\alpha=0.889$ ), “production or work pressure” ( $\alpha=0.763$ ), and “competence” ( $\alpha=0.736$ ).

#### **2.4.5.4 Self-reported involvement in occupational accidents**

Three items in the questionnaire measured the employees’ self-reported involvement in occupational accidents while offshore. First the respondents were asked to report (1=yes and 2=no) whether they had experienced any accidents at work during the last year. Thereafter, they were to report whether any accidents had been reported to a supervisor or to the medical staff onboard the installation (1=yes or 2=no). If an accident had been reported the respondents were asked to indicate how the accident had been classified. Six response categories were provided for the purpose of classifying occupational accidents: 1=only examination, 2=first aid, 3=medical treatment, 4=alternative work, 5=absence or 6=serious injury to personnel.

#### **2.4.5.5 Work group**

One of the aims in paper III concerned the relationship between perceptions of work safety climate, work environment, health, and self-reported involvement in occupational accidents in different work groups. The questionnaire included a background variable with eight response alternatives for the classification of work groups: 1=process workers, 2=drilling personnel, 3=well-services personnel, 4=accommodation personnel, 5=construction/modification personnel, 6=maintenance personnel, 7=crane/deck operators and 8=other (see Table 2.4).

### **2.4.6 Measures applied in paper IV<sup>20</sup>**

Paper IV was based on a combination of qualitative and quantitative approaches to examine the effects of a large-scale safety programme implemented by a Norwegian petroleum company. The objective of the safety programme was to improve the company’s safety performance through improving the employees’ safety behaviour and the safety culture. The safety programme was aimed at all the personnel in the company as well as contractors and consultants bound by contract for a longer period of time.

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<sup>20</sup> The measure/questionnaire used in paper IV are shown in paper IV. The questionnaire used in paper IV was only available in Norwegian. The specific items used are also included as an appendix in paper IV.

#### **2.4.6.1 Qualitative approach**

An interview guide was developed before the interviews were conducted. The intention of the interview guide was to explore the interviewees' perceptions, understandings, and feelings about the safety programme design and implementation in the enterprise. The qualitative interviews were conducted in the interviewees' workplaces one to two years after the respondents had participated in the safety programme. As part of the qualitative approach adopted in paper IV, fieldwork observations were conducted on three offshore installations, one onshore gas plant, and three other onshore units. The fieldwork consisted of stays in the departments of the operator and contractors, informal discussions during coffee breaks etc. The researchers also participated in meetings with personnel safety representative and managers. In order to evaluate the research findings from the fieldwork, summary notes were written from each session. These notes were handed to key personnel in order to assure the correct interpretation of the results.

In addition to the interviews and fieldwork, focus discussion groups were conducted immediately after the first (N=11) and second day (N=12) kick-off gatherings implemented in the enterprise. The rationale behind the focus discussion groups were firstly to obtain knowledge regarding how the employees evaluated all the measures used as part of the kick-off gathering and secondly to obtain knowledge for how to improve the kick-off gathering further before it was implemented in the remainder of the organisation.

#### **2.4.6.2 Quantitative approach**

The qualitative data were used as a basis for developing five concepts for inclusion in the structural model: 1) participation in a two-day kick-off, 2) effectiveness of programme implementation, 3) personal programme commitment, 4) safety behaviour change, and 5) safety culture change. The final version of the questionnaire consisted of 83 items, including demographic characteristics. The development of the survey used in paper IV was based on existing methodological knowledge concerning survey development, and knowledge about interventions implemented as part of the safety programme that were examined. All of the used items in the questionnaire were rated on Likert-type scales with verbal anchors.

#### **2.4.6.3 Participation in the two-day kick-off**

Participation in the safety programme was mandatory in the enterprise. The questionnaire asked the respondents if they had participated in the two day kick-off gathering implemented in the organisation, providing two response alternatives (1=yes, 2=no). Participation in the

two-day kick-off was used as an *endogenous* variable (i.e. the dependent variable) in the hypothesised structural model.

#### **2.4.6.4 Effectiveness of programme implementation**

The implementation of the safety programme was viewed as an organisational change process; hence, a high level of management commitment as well as personal involvement was considered essential for the success of the programme. The effectiveness of programme implementation was measured by 10 items, drawn from three scales: 1) satisfaction with the safety programme, 2) knowledge concerning the safety programme and 3) management (see Appendix IV). The items were measured on Likert-type scales with verbal anchors. The scales also included a “do not know” response alternative.

#### **2.4.6.5 Personal programme commitment**

Personal programme commitment measured the degree to which workers followed up their personal commitment to the programme. Two items were used: 1) Have you been talking with your colleagues about your personal commitments, and 2) Have you followed up your personal commitment? These items were measured on six-point Likert-type scales ranging from 1=to a very little extent, to 6=to a very large extent.

#### **2.4.6.6 Safety behaviour change**

Safety behaviour change involved nine items and measured the degree to which workers believed that their safety behaviour had changed as a consequence of participating in the safety programme. Examples of items are: “I take my own initiatives to improve safety”, “I have open dialogues about risk”, and “I pay attention to risk in the job”. The respondents evaluated the items on six-point scales ranging from 1=worse after the safety programme to 6=better after the safety programme.

#### **2.4.6.7 Safety culture change**

Safety culture change aimed to measure the degree to which workers perceived that the implemented safety programme had improved the enterprises’ safety culture. Three items were included: “The safety programme has helped improve the safety status where I work”, “The safety programme has reduced unwanted incidents in my department”, and “The safety programme has contributed to improving the safety culture in the overall organisation”. These items were measured on six-point scales ranging from 1=completely disagree to 6=completely agree.

## 2.5 Statistical analyses

The Statistical Package for the Social Sciences (SPSS) analysis program version 13.0 and the Linear Structural Relation (LISREL) analysis program version 8.70 were used to analyse the data in papers I to IV. Several statistical analyses were conducted and these are displayed in Table 2.6.

*Table 2.6 Overview of the different statistical analyses performed in the three papers that are included in the thesis*

	Paper I	Paper II	Paper III	Paper IV
<b>Basic descriptive statistics</b>	X	X	X	X
Analyses used to examine dimensionality				
<b>Principal component analyses with Varimax rotation, using Kaisers criterion and the Scree plot</b>	X	X	X	X
<b>Confirmatory factor analyses</b>	X	X	X	X
<b>Internal reliability analyses (Cronbach's alpha)</b>	X	X	X	X
<b>Correlation (Pearson's r)</b>	X			
Analyses to examine differences				
<b>Independent sample t-test</b>			X	
<b>Chi square test</b>		X		
<b>Analysis of variance (ANOVA)</b>	X	X	X	
<b>Multivariate analysis of variance (MANOVA)</b>	X	X	X	
Analyses to examine relationships				
<b>Multiple regression analysis (stepwise)</b>	X			
<b>Structural equation modelling</b>		X	X	X

### 2.5.1 Analyses used to examine dimensionality

Correlation refers to a type of statistics that investigates the relationship between variables. In the present thesis, several analyses that are based on correlations were employed. These are reviewed in the following sections.

*Principal component analyses* were applied in papers I to IV to detect the underlying dimensions of the items measuring subjective health complaints, perception of risk, and the work safety climate. These analyses were exploratory, and they were conducted with Varimax rotation to obtain orthogonal (i.e. uncorrelated) factor structures. Kaiser's criterion (i.e. retaining factors with an eigenvalue exceeding 1) and the Scree plot (which shows graphically the sorted eigenvalues from large to small) were applied in order to detect the number of underlying dimensions in the specified data materials.

The Linear Structural Relation (LISREL) analysis program (Jöreskog & Sörbom, 2004) was used in all the included papers for *confirmatory factor analyses*. A confirmatory factor

analysis is a statistical technique to confirm a hypothesised factor structure. Confirmatory analyses were applied both to test existing factor structures (e.g. perceived control from the QPS-Nordic, in paper I) and also to validate the structures extracted in the principal component analyses in a second sample (e.g. work safety climate in study II), and hence to make the dimensions more robust for later use in the structural equation modelling.

The *Cronbach's alpha coefficient* (Cronbach, 1951) was used to determine the reliability, or the internal consistency, of all the extracted dimensions used in the present work, such as perception of job demands (paper I), work safety climate (paper II), perceptions of the work environment (paper III), and safety behaviour change (paper IV). Cronbach's alpha was also applied to evaluate the internal consistency of the identified theoretical dimensions used in paper I (i.e. subjective health complaints) and paper III (i.e. work safety climate).

The  $\alpha$  is an estimate of the correlation between two random samples of items from a universe of items like those included (Cronbach, 1951). It assumes that if a dimension has high internal consistency (i.e. a high  $\alpha$  value) it is psychologically interpretable. According to the original article by Cronbach (1951), it is stated that the appropriate degree of reliability depends not only on the strength of the relationship but also on the use of the instrument, e.g. an instrument designed to be used as part of a battery may be intentionally designed to be as short as possible and thus somewhat less reliable. It should also be noted that, although a high value on the alpha coefficient might seem ideal, an index does not necessarily need a high Cronbach's alpha value to be useful. Furthermore, the alpha value is sensitive to the number of included items, and as the number of items increases, the alpha will (usually) also increase. This should be considered when evaluating the homogeneity of the included items in a dimension.

*Correlations* were estimated in LISREL to examine the associations between health, safety, and the work environment. The Pearson's correlation coefficient was applied in paper I to examine the relationship between the included dimensions.

### **2.5.2 Analyses aimed at exploring differences between groups of workers**

A central purpose of the presented work was to explore differences between groups of workers in the oil and gas industry. Differences were examined on the basis of their place of work (e.g. onshore and offshore, in paper I), of different work groups (in papers I and III), and based on data collected at different points in time (paper II).

The *independent sample t-test* was performed to examine the difference between employees who had experienced an occupational accident at work and those employees who had not (paper III). The independent sample t-test assesses whether the means of the two groups are statistically different from each other. Levene's test for equality of variances tests whether the two groups have approximately equal variances on the dependent variable included in the analysis. If the Levene's test is significant, it indicates that the variances of the two independent groups are significantly different. The independent sample t-test presupposes that the data are normally distributed and are measured at the interval level.

A *chi square analysis* was used in paper II to examine differences between the 2001 and 2003 employees regarding symptoms of ill health. A chi square ( $\chi^2$ ) is used to investigate whether distributions of categorical variables differ from each other. Due to the fact that the measurement of health symptoms used in the second paper violated the assumption of normally distributed data, this was controlled for by applying the chi square to the data to examine the differences between the two year groups (i.e. 2001 and 2003).

*One-way analyses of variance (ANOVA)* were conducted as part of papers I, II and III. The ANOVA allows for comparisons between several independent groups and tests whether the group means are equal or differ significantly from each other. *Bonferroni's post hoc test* was also used to identify which of the groups differed significantly. The Bonferroni test is based on the related t-test but modifies the significance level to take account of the fact that more than one comparison is being made. Furthermore, the Bonferroni test calculates a new alpha to keep the familywise alpha at 0.05.

In papers I to III the *multivariate analysis of variance (MANOVA)* was applied. The MANOVA is used in situations where there is more than one dependent variable. It is also used to identify interaction effects among the dependent variables and among independent variables (Stevens, 2002). Post hoc comparisons may be performed as part of the MANOVA analysis to investigate the extent to which values contribute to the explanation of the dependent variables. Covariates may also be used in the MANOVA analysis. These are variables that are related to the dependent variables, which cannot be manipulated, but where the aim is to remove their relationship from the dependent variables before assessing differences in the independent variables. In other words covariates are used to eliminate



systemic errors, serving as control variables for the independent factor. The MANOVA analyses applied in papers I to III examined both main effects and interaction effects.

*Wilk's lambda* ( $\lambda$ ) was used as a measure of the difference between the groups on the mean of the independent variables within the context of all three papers presented in the thesis. Wilk's lambda is a test available in multivariate analyses to assess whether the means of the groups differ significantly on a discriminant function or characteristic root. In paper I the aim was to examine the effect of onshore and offshore work on the following variables: job demands, perceived control, risks/hazards associated with the work tasks, external influences on work performance, and perception of the organisation's commitment to and work with issues related to employee health and the work environment. Employee age and seniority in the current occupational position were used as covariates in paper I.

In paper II the MANOVA was conducted to examine the effect of year group (i.e. the 2001 and the 2003 sample) and age group on health, limitations in daily activities vis-à-vis the reported health impairments, and several work-related variables (i.e. the overarching indices of perceived work safety climate, perception of risk, and perception of the work environment). Since the data in paper II were drawn from two different samples, the age distribution could be assumed to be of specific importance to the health and work dimensions. Therefore, the age variable was included as a fixed factor in the MANOVA analyses in paper II.

In paper III a MANOVA analysis was conducted to examine the difference between different work groups in terms of perceived work safety climate, perception of the work environment (i.e. the physical and the psychosocial work environment), and the respondents' subjective health status (i.e. general health status and symptoms of ill health). Age group and years of experience in the current occupational position were used as covariates in paper III.

### **2.5.3 Analyses aimed at exploring relationships between health, safety, and the work environment**

The present work sought to examine the relationship between work- and organisation-related variables on employee self-reported health. Furthermore, paper IV sought to examine the effect of a large-scale safety programme on the employees' perception of safety behaviour change and safety culture change. A short description of the analyses used to achieve these goals is provided below.

A *multiple regression analysis* was applied in order to examine the relationships between specified sets of predictors and dependent variables in paper I. The stepwise technique, using the default forward procedure, was applied. In such a regression model each variable is entered and its value assessed. The variables added to the final model are the ones that make the greatest reductions in the error sum of squares of the sample data. Equivalently they are the variables that when added provide the greatest increase in the F value. Variables without a significant correlation with the dependent variable are those whose addition does not increase the F value and these are not featured in the regression equation. Through the process of a stepwise multiple regression only the significant predictor variables are included in the final model.

Different forms of *Structural Equation Model* (SEM) analyses were employed in papers II, III, and IV. SEM modelling allows for an exploration of the patterns of inter-relationships between variables by creating a measurement model and a structural model (Bollen, 1989). In paper II, two separate LISREL models were estimated, one based on the 2001 sample and one based on the 2003 sample, investigating the effect of work safety climate, risk perception, and work environment upon symptoms of ill health and on limitations in daily activities vis-à-vis the reported health impairments. Subjective health complaints and perceived limitations in daily activities were treated as ordinal variables in the LISREL estimations. In paper IV, participation in the two-day kick-off and the items measuring personal programme commitment were treated as ordinal variables in the following LISREL estimations. To incorporate ordinal variables in LISREL requires that threshold values are estimated, a test of underlying normality and of polychoric correlations are performed (Jöreskog, Sörbom, DuToit, & DuToit, 2001). The polychoric correlation is an estimated correlation that is assumed to be coarsely categorised (resulting in observed ordinal variables) (Diamantopoulos, & Siguaw, 2000).

Observations on an ordinal variable represent responses to an ordered set of categories. The use of ordinal variables in LISREL estimation requires other estimation techniques than those employed with continuous variables (Jöreskog, 2005). This is because the data do not follow a multivariate normality distribution. In papers II, III, and IV, therefore, the included variables were estimated by first applying PRELIS in order to obtain the polychoric correlations and the asymptotic covariance matrix. After the initial PRELIS procedure, different estimation techniques were applied: the Weighted Least Squares estimation method was applied in paper

II, whereas the Robust Maximum Likelihood estimation method was applied in papers III and IV.

The *weighted least squares method* (WLS) attempts to give each data point its proper amount of influence over the parameter estimates. The WLS method is based on the polychoric correlations and its asymptotic covariance matrix (obtained through PRELIS), and it gives correct standard errors and chi squares in larger samples (DuToit & DuToit, 2001; Jöreskog et al., 2004). When dealing with data that are not normally distributed, a procedure that treats all of the data equally would give less precisely measured points more influence than they should have, and would give highly precise points too little influence (Croarkin & Tobias, 2006). The main advantage of the WLS procedure is the ability to handle regression situations in which the data points are of varying importance. If the standard deviation of the random errors in the data is not constant across all levels of the explanatory variables, using the WLS estimator with weights that are inversely proportional to the variance at each level of the explanatory variables yields the most precise parameter estimates possible. The asymptotic covariance matrix is defined as the covariance matrix of the parameter estimates (Preacher, Curran, & Bauer, 2006).

To estimate the relationship between the perception of the work safety climate, risk, work environment, and subjective health, *MIMIC* (Multiple Cause Multiple Indicators) models were constructed, taking the subgroup structure in the data into account. The subgroup part of the model was represented by contrasts constructed from the age variable. The latent factors of work safety climate, risk, work environment, health, and perceived limitations in daily activities were estimated introducing the subgroup effects represented by age. One aim was to examine differences between the 2001 and 2003 employees, and it was therefore assumed that the age distributions of the samples could be of specific importance. The respondents' reported age was measured as a categorical variable, which required the measurement parameter of age to be corrected for subgroups' tendencies, i.e. specific tendencies within each age group (Hagtvet & Sipos, 2004). On the basis of the categorical age variable, three Helmert contrasts were constructed, each with its own latent indicator. A Helmert contrast compares each level of a categorical variable to the mean of the subsequent levels. These contrasts were thereafter included in the structural equation models (i.e. the estimated model for 2001 and 2003, respectively). The assumption was that age would influence perceived health status directly, and also through health, influence perceived limitations in daily activities offshore vis-à-vis the reported health complaints.

In paper III, the *Robust Maximum Likelihood* procedure was used as the estimation method. This method is recommended as an alternative to the WLS if the data do not follow a multivariate normal distribution. To implement the robust maximum likelihood method for covariance structures an asymptotic covariance matrix needs to be computed.

Different goodness of fit indices was used to evaluate the fit of the models estimated in papers II, III, and IV. These included: the Satorra–Bentler scaled  $\chi^2$ , degrees of freedom relative to the  $\chi^2$  statistic, the RMSEA (Root Mean Square of Error Approximation), the NNFI (Non Normed Fit Index), and the CFI (Comparative Fit index).

The *Satorra–Bentler scaled  $\chi^2$*  is a multivariate kurtosis estimate that is used to scale or correct the chi square value and standard errors. It incorporates a scaling correction for the chi-square statistic when distributional assumptions are violated (Satorra & Bentler, 2001). It is important to note however, that the  $\chi^2$  is influenced by sample size (Miles & Shevlin, 2007). The *Root Mean Square of Error Approximation* (RMSEA) measures discrepancies per degrees of freedom and does not require any comparison with a null model. Values on the RMSEA below 0.10 have traditionally been interpreted as an acceptable fit to the data at hand (Steiger, 1990). The *Comparative Fit Index* (CFI) compares the existing model fit with a null model that assumes that the latent variables in the model are uncorrelated. The CFI should be greater than or equal to 0.90 to accept the model, indicating that 90% of the covariation in the data can be reproduced by the given model. The *Non Normed Fit Index* (NNFI) was also used as an indicator of goodness of fit in the present studies. The NNFI penalizes the model for complexity, and it is not guaranteed to vary between 0 and 1. Values on the NNFI close to 1 indicate a good fit. Hu and Bentler (1998) suggested that values below 0.95 indicate a need to respecify the model (Hu & Bentler, 1998). Additionally, in the confirmatory factor analyses as part of paper I the *Normed Fit Index* (NFI) was applied. The NFI is a measure which rescales the chi-square ratio into a 0 (no fit) to 1 (perfect fit) range (Bentler, & Bonett, 1980).

SEM modelling assumes that all the variables employed are continuous and normally distributed. However, some of the variables used in the present context were not continuous or normally distributed. For instance, subjective health was, in paper II, measured with dichotomous response categories. This represented a problem because it limited the respondents' ability to account for their health status in a more detailed manner. Furthermore, dichotomous variables do not provide information concerning the degree of affliction from a specific symptom. Scales that measure the frequency, intensity, and duration of a symptom

would be better because they would allow the subject to rate various aspects of the specific symptoms rather than just responding yes or no. However, in the present context a lot of care was taken to correct for the use of dichotomous response categories. The dichotomous variables (i.e. health in paper II and occupational accidents in paper III) and the item with three response alternatives (i.e. perceived limitations in daily activities, in paper II) were first run through PRELIS in order to obtain polychoric correlations, and additionally to obtain an asymptotic covariance matrix.

Finally, the respondents were asked to indicate whether they had experienced the ill health symptoms (such as musculoskeletal problems) in the course of three months. This might represent a problem because there are profound uncertainties about recall and the reliability associated with reporting symptoms backwards in time (Dallner et al., 2000). Continuous measurement over longer time periods of the same individuals would certainly be very helpful to increase the data reliability.

SEM modelling offers the option of *model modification*. This option was not used in the SEM modelling in paper II and paper III of the present thesis, but it was used in the fourth paper. The goal of model modification is to respecify the model by either adding or deleting paths, in order to increase the fit of the model. According to Kelloway (1998), such respecifications of a given model are post hoc by definition, i.e. they are empirically or exploratory, as opposed to theoretically, generated. As the purpose in papers II and III was to test parsimoniously developed models, the option of model modification was omitted from these analyses (Kelloway, 1998). In paper IV, however, the model was respecified for exploration purposes.

## **2.6 Summary**

To sum up the methodological section and the approaches adopted in this thesis, a short descriptive account will be provided of the methods used in the papers that are part of the present thesis.

The purpose of paper I was to examine the effects of work- and organisation-related variables on offshore and onshore employees' self-reported health status, and also to examine differences between employees working at the two respective locations. The questionnaire used in paper I was composed of questions concerning job and organisation factors as well as employees' health perceptions. The sample consisted of 414 employees (response rate: 47.1%) in a multinational contractor company conducting maintenance and modification

commissions. The sample was divided into employees who worked primarily onshore (N=290, response rate: 50.2%), and offshore (N=115, response rate: 30.0%). The data were analysed by applying analyses based on correlations between variables and analyses aimed at examining differences between different groups of workers (see table 2.6).

Paper II examined the relationship between work and health perceptions and explored differences between employees by using two samples consisting of offshore oil employees, collected at two different points in time (i.e. 2001: N=3310, response rate: 49%, and 2003: N=8567, response rate: 50%). The data collection procedure was externally controlled by the Norwegian PSA. The questionnaire included items intending to measure the work safety climate and work environment factors as well as self-reported health complaints. The data were analysed by statistical techniques aimed at examining differences between the two samples, and analyses aimed at examining the relationship between the work safety climate, risk, work environment, and self-reported health complaints.

The purposes of paper III were: a) to explore the relationship between health, safety, and the work environment and b) to examine the influence of HSE variables on employee health perceptions and self-reported involvement in occupational accidents in eight different offshore work groups. Paper III was based on a large externally controlled data set, collected by the PSA through the TRL project (N=9945, approximate response rate: 50%). Paper III employed exploratory and confirmatory factor analyses and Cronbach alphas were computed for all the measurement concepts. An independent samples t-test and multivariate analysis of variance were conducted to examine difference based on work group. SEM analyses were conducted to examine the relationship between HSE related variables and individual-level outcome variables (i.e. subjective health and occupational accidents).

Paper IV was included in this thesis because it complements the literature on safety culture/climate by also incorporating qualitative methodology into the research design. A qualitative methodology (interviews, N=151, fieldwork observations, and focus group discussions) was used in the development of a questionnaire that included five theoretical concepts that were to be included in a structural model. Questionnaire data was collected as part of paper IV (N=1221, response rate: 40%). Paper IV used exploratory factor analyses to develop measurement concepts that were used in the SEM model. Robust maximum likelihood was used as the estimation method to replicate the measurement model and in the assessment of the structural model.

Any research that is based on measurement must be concerned with the reliability and the validity of the results presented (Cronbach, 1951). Reliability is the extent to which an experiment, test, or any measuring procedure yields the same result on repeated trials. Generally, across the studies included in this thesis, the reliability of the measures and indexes used were considered satisfactory. If that was not the case, single items were used in the analyses, as described in the previous sections. To ensure the reliability of the dimensions used in the present work, exploratory factor analyses were used to identify latent dimensions. These dimensions were also tested by using confirmatory factor analyses in a second step. Such a procedure will increase the reliability of the dimensions. Also, in paper II, the factor structures that were identified through exploratory analyses (i.e. on the 2001 sample) were tested in an additional sample of similar workers (i.e. the 2003 sample) collected at a different point in time. This procedure has contributed to increasing the reliability of the included dimensions in this thesis.

Generally, while reliability is concerned with the accuracy of the actual measurement issue or procedure, *validity* is concerned with the study's success at measuring what the study set out to measure. It is important that a test is valid in order to apply and interpret accurately the results from the tests applied in the work presented. External validity refers to the extent to which the results of a study are generalisable or transferable. Two of the papers included in this thesis are based on large externally controlled data sets. The PSA has collected data from large parts of the offshore working population at three different times. The PSA states that the questionnaire has been developed in close cooperation with external research institutions, and that it to a large extent builds on acclaimed and tested measuring instruments, such as the QPS-Nordic (PSA, 2007). Furthermore, in order to secure the integration of the most relevant items concerning risk and safety offshore, interviews were conducted with representatives from the Norwegian oil and gas industry (PSA, 2000). Based on this it is reasonable to assume that the results from the questionnaire studies conducted by the PSA give a good picture of the employees' perception of the HSE conditions at their offshore workplaces. The Norwegian PSA has also stated that the collected samples constitute representative samples of the offshore working population during the three specific time periods (PSA, 2001; PSA, 2003; PSA, 2006). This is also believed to increase the external validity of the results.

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## 3 RESULTS

### 3.1 Summary of the results reported in paper I

*WORK AND HEALTH – A COMPARISON BETWEEN NORWEGIAN ONSHORE AND OFFSHORE OIL  
AND GAS EMPLOYEES*

The purpose of paper I was to examine the effect of work- and organisation-related variables on the employees' perceptions of subjective health complaints in a sample including both onshore and offshore workers. The workers were employed within the maintenance and modification division of a large contractor company that had commissions on the Norwegian continental shelf and also internationally. Subjective health complaints were measured by the dimensions of musculoskeletal complaints and "pseudo-neurology", providing the employees' perception of the physiological and psychological aspects of subjective health status, respectively. Work- and organisation-related variables included employee perceptions of job demands, control at work, and perceived risk/threats associated with the work tasks. Work- and organisation-related variables also included the workers' perception of external influences on work performance (e.g. reorganisations) and how they perceived the organisation's commitment to and work with issues related to employee health and the work environment (e.g. the company arranges the working conditions so that the individual's health is not injured).

Paper I also sought to examine differences in subjective health complaints and the work- and organisation-related variables between onshore and offshore workers, and also with regard to occupational positions, or job types at those two respective locations. One assumption was that offshore and onshore personnel, employed in different occupational positions, would perceive their work environment and their subjective health status differently, i.e. that there would be differences both *between* the groups and also *within* the two respective groups. Furthermore, it was assumed that the included psychosocial work and organisation factors would influence employee health perceptions in the onshore and offshore work environments.

Overall, the onshore and offshore workers reported few physiological and psychological subjective health complaints, i.e. they represented healthy employees. No significant differences could be identified between the major groups of onshore and offshore

workers in terms of psychological and physiological health perceptions. However, the results in paper I showed that a larger variation in health perceptions was found within the respective groups than between the major groups, indicating that different job types involve different threats to employee health and well-being. The variations in health perceptions based on job type were larger in the onshore sample than in the offshore sample. The result was interpreted in terms of the offshore work group being a somewhat more homogenously healthy group of workers. Furthermore, the job type in the onshore work environment exerted a significant influence on the employees' perception of their *physiological* health status, but not on their reporting of psychological health status. Corresponding differences were not identified between workers in different occupational positions in the offshore work environment.

Differences were identified between onshore and offshore employees with regard to perception of job demands. More specifically, differences were identified between onshore and offshore employees in terms of the dimensions "pressure at work" and "repetitive work". The onshore employees perceived more pressure at work; they also perceived that their work tasks were more repetitive than the offshore workers. Offshore workers, on the other hand, seemed to experience less control over the work pace and less control over decisions compared with their onshore counterparts. Offshore workers also perceived more hazards associated with the work tasks (e.g. work with dangerous tools and materials). Analysing the employees' perception of the external influences on work performance revealed one significant effect, and the offshore group had more concerns regarding separation from family and friends.

The type of job, onshore and offshore, revealed a significant main effect relative to the work-related variables included in paper I. In the onshore work environment, administrative workers perceived more demands associated with work compared with steel workers. Engineers also perceived more control over their work tasks than did pipe workers, steel workers and service personnel. In the offshore work environment, engineers perceived more demands at work as compared with the other included work groups.

Overall, the work- and organisation-related variables in paper I accounted for a small percentage of the variance in offshore and onshore employees' self-reported physical and psychological health status. However, work-related variables accounted for a larger

percentage of the explained variance in *onshore* workers' physical and psychological health status (14.0% and 14.5%, respectively) than they did in the offshore group (physical health: 4.2% and psychological health: 9.8%). Thus, different work-related variables influenced employee perceptions of physical and psychological health status to some extent in the onshore and offshore work environments. For instance, in the onshore sample the largest contributing factor to self-reported physical health status was the perception of hazards associated with the work task, while the largest contributing factor in the offshore sample was the employees' perception of their work as repetitive.

The results reported in paper I supported to some extent the assumption that there existed differences between employees working primarily onshore and offshore with regard to their perception of work- and organisation-related variables, i.e. job demands, control, hazards associated with work tasks, and external influences on work performance. It is, however, important to note that these differences were quite small. In terms of health perceptions, the variance within the separate work groups was larger than the variance within the two major groups (i.e. onshore and offshore workers).

### **3.1.1 The main results from paper I**

- The respondents constituted a healthy sample, reporting few physiological and psychological health complaints.
- Health perceptions varied across occupational tasks within the major groups, but there was no difference identified between the onshore and offshore personnel groups.
- Differences were identified between offshore and onshore employees particularly with regard to the perception of job demands (a higher perception onshore), perceived control, and the perception of hazards associated with the work tasks.

## **3.2 Summary of the results reported in paper II**

### *SAFETY, HEALTH AND WORK ENVIRONMENT – A STUDY OF EMPLOYEES IN THE NORWEGIAN OFFSHORE OIL INDUSTRY*

Two large cross-sectional surveys provided the basis for paper II. The specific objectives of the second paper were to examine the effect of employee perceptions of the work environment (i.e. physical and psychosocial), risk and the work safety climate on employees' self-reported health status. It was assumed that the employees' self-reported

health status, in turn, would influence the respondents' perceptions of limitations in their daily work activities offshore based on the reported health impairments. Paper II also sought to examine differences between the 2001 and 2003 samples of offshore employees in terms of work and health perceptions.

Self-reported health status, as measured in paper II, was defined in terms of symptoms of ill health that had affected the respondents during the last three months prior to the surveys. These were symptoms such as musculoskeletal problems, dermatological problems, and psychological complaints (e.g. depression, anxiety). The work-related aspects included perceptions of the psychosocial work environment (e.g. social relationships at work), the physical work situation offshore (e.g. noise, weather protection, etc.), perceived risks at work (e.g. blowouts, fires), and perception of the work safety climate (e.g. a lack of communication about safety, dangerous tendencies, communications about safety).

Both samples represented healthy work groups supporting previous research stating that obvious illness among offshore oil workers is relatively rare. Only a small fraction within each sample described their general health status as poorer than satisfactory (0.7% in 2001 and 0.6% in 2003), whereas the majority of the employees described their current general health status as "good" or "very good". With regard to the specific symptoms of ill health, the results showed that 55% of the workers in 2001 and 57% of the workers in 2003 had experienced at least one of the included ill-health symptoms during the three months prior to the questionnaire study in 2001 and 2003. Musculoskeletal complaints appeared to be the most frequently reported type of complaint in both samples (i.e. 2001 and 2003), and affected 35.8% and 37.8% of the workers, respectively. Dermatological health complaints also appeared quite frequently, and every fifth person in the two samples reported this kind of problem. The ill-health symptom that was least common among the total sample in 2001 and 2003 was cardiovascular disease (1.5% and 1.6%, respectively).

Significant differences were identified between the year groups of 2001 and 2003 with regard to hearing impairments and musculoskeletal complaints. A larger part of the 2003 employees (17.1% and 39.0%, respectively) reported these health complaints than the employees in the 2001 sample (15.7% and 36.5%, respectively). With regard to perceptions of their current general health status, the results showed that the 2003

employees evaluated their general health status as slightly better than the 2001 employees. Differences were also identified with regard to employee age and health perceptions. The results indicated that the older employees (i.e. between 50 and 67) perceived their general health status as less satisfactory than the younger employees' and this was the case in both samples. The results also indicated that the older workers (both in 2001 and 2003) reported a higher frequency of ill-health symptoms. Older employees (i.e. between 50 and 67) in 2001 and 2003 also experienced more limitations in their daily work activities offshore vis-à-vis the reported health complaints compared with their younger colleagues.

Composite indices measuring the work safety climate, perception of risk, and perception of the work environment were constructed to compare year groups (2001 and 2003) and age groups. The results showed differences between the two year groups with regard to perception of the work safety climate, perception of risk, and perception of the work environment. The 2003 respondents appeared to be more satisfied with the safety standards at work, they perceived fewer risks associated with work, and they were generally more satisfied with aspects of their work environment (i.e. psychosocial and physical aspects) compared with the 2001 employees. Younger workers (below 30 years of age), in both samples, generally experienced more risks associated with work. They were also less satisfied with aspects related to the work safety climate and showed a more negative perception of the work environment compared with their older counterparts in both samples.

The age distributions of the employees were thought to be of specific importance when examining the influence of work-related variables on the respondents' perceptions of health status. The inclusion of age in the referred to analyses required the measurement parameter estimates to be corrected for subgroup tendencies, here represented by age (Hagtvet et al., 2004). Thus, three age contrasts were constructed to be included in structural equation models conducted as part of paper II. The assumption was that age could influence perceived health status directly, and also exert an indirect influence (through health) on the respondents' perceptions of limitations in daily work activities vis-à-vis the reported health complaints.

Perceptions of the work safety climate, risk, and the work environment along with the three age contrasts accounted for 13.9% of the variance in subjective health complaints in

the 2001 sample. In the 2003 sample these variables accounted for 11% of the variance in subjective health complaints. Perception of health status exerted a great influence on the respondents' reports of limitations in daily activities vis-à-vis the reported health impairments, i.e. 57.2% of the variance in 2001 and 71.0% of the variance in 2003. Overall the results indicated that the respondents' age contributed significantly to the perception of (ill-) health. The results showed that the effect of age on employee health perceptions were particularly strong for employees between the ages of 31 to 40. This result was found in both samples, i.e. in 2001 and 2003.

### **3.2.1 The main results from paper II**

The main results reported in paper II can be summarized as follows:

- The majority of both samples perceived their general health status as “good” or “very good”, i.e. the offshore employees in 2001 and 2003 constituted healthy work groups.
- Older employees (i.e. over 50 years of age) reported a higher frequency of ill-health symptoms and also evaluated their general health status more negatively, both in 2001 and 2003.
- The employees' perceptions of the work environment, the work safety climate and risk accounted for a small percentage of the variance in self-reported symptoms of ill-health. A strong relationship was found between subjective health status and the respondent's reporting of limitations in daily work activities offshore.
- A gap was identified between the employees' perception of their general health status and the frequency of reported ill-health complaints. This result indicates that, despite the fact that the workers experience specific symptoms of ill health, they still evaluate their current general health status as good or very good.
- Differences between the year groups were identified with regard to work-related variables and the employees' self-reported health status. The 2001 employees evaluated their general health status more negatively and they perceived more limitations in their daily work activities offshore vis-à-vis the reported health complaints, than did the 2003 employees. The 2003 employees appeared to be more satisfied with the safety standards, they perceived less risk, and they appeared to be more satisfied with the

physical and psychosocial work environment aspects compared with the 2001 employees.

- Differences between age groups were identified: older employees (i.e. employees older than 50 years of age) appeared to be more satisfied with the work safety climate, and they perceived less risk associated with work. Older employees also perceived the work environment as more positive, both in 2001 and 2003.
- Employee age was the factor that was most strongly related to ill-health symptoms, and the effect was strongest for employees between 31 and 40 years of age.

### **3.3 Summary of the results reported in paper III**

#### *HEALTH, ENVIRONMENT, SAFETY CULTURE AND CLIMATE – ANALYSING THE RELATIONSHIPS TO OCCUPATIONAL ACCIDENTS*

The objectives of the third study were to examine the relationship between the three more specific parts of the composite HSE concept, namely the relationship between employee health, the work safety climate, and the physical and psychosocial aspects of the work environment. The effects of work- and organisational-related variables upon self-reported health status and on self-reported involvement in occupational accidents were also investigated, within more specific work groups, in the offshore work environment. The following work categories were used: 1) process workers, 2) drilling personnel, 3) well-services personnel, 4) accommodation personnel, 5) construction/modification personnel, 6) maintenance personnel, 7) crane and deck operations and 8) other.

Significant correlations were found between the health, safety, and work environment variables. The correlations varied between  $r=0.375$  (between health and the work safety climate) and  $r=0.813$  (between subjective health and perceptions of the work environment). The employees' perception of their current general health status constituted the best predictor of the overarching latent dimension of health. The perceived health symptoms gave weaker factor loadings up to the latent overarching health dimension. The indices measuring the work safety climate loaded strongly on the overarching dimension and the results therefore suggested that the five theoretical dimensions used provided a satisfactory representation of this overarching concept of work safety climate. With regard to the work environment aspect inherent in the composite concept of HSE, the results showed that the perception of work ability related

to the physical and psychosocial demands posed by the work were the most descriptive of the overarching latent dimension of work environment. The employees' perception of work ability related to physical and psychosocial demands were measured as two single items in paper III.

Differences between work groups were examined with regard to perceptions of health status, including both ill-health symptoms and the perception of general health status, the physical and the psychosocial work environment, and the employees' perception of the work safety climate. Differences were also examined with regard to self-reported involvement in occupational accidents while offshore. The results showed that the measured factors varied across the different work groups. Specifically, the results showed that accommodation personnel reported a higher frequency of ill-health symptoms whereas maintenance personnel perceived their general health status as less adequate than the other work groups. With regard to the evaluation of the physical work environment conditions, the results showed that the well-services workers perceived these aspects the most negatively. This group of employees was also more dissatisfied with the perceived safety climate compared with the other seven work groups.

In addition to examining the effect of the work group on HSE-related aspects, paper III examined the effect of age group on work and organisation-related variables, i.e. work safety climate, physical and psychosocial work environment, and health. The results showed that age significantly influenced all these aspects. Older employees experienced a higher frequency of ill-health symptoms and also perceived their general health status in a more negative manner than others. The younger employees (i.e. between 20 and 30 years of age) were less satisfied with the physical and psychosocial work environment. They also evaluated the work safety climate in a more negative manner.

The influence of the work safety climate and the physical and psychosocial work environment on employee health and self-reported involvement in occupational accidents was estimated by using structural equation modelling (SEM). The model was estimated in the total sample, as well as in the eight individual work groups. The results showed that the included variables accounted for a moderate amount of the variance regarding the number of experienced occupational accidents in the overall sample (2.4%). Dimensions measuring the work safety climate and work environment accounted for 22.1% of the variance in reported symptoms of ill health in the total sample and 9.7% of the variance



in general health status. The employees' perception of the physical work environment was the strongest predictor of the number of experienced occupational accidents. The perception of the work safety climate contributed significantly to the explanation of occupational accidents, but to a lower extent than the physical and psychosocial aspects of the working environment. General health status did not contribute significantly to the measure of the experienced accidents used as part of paper III.

The strongest explanatory variable for general health status in paper III was the psychosocial aspects of the work environment, e.g. support from the immediate supervisor and perceived challenges at work. The perception of the physical work environment exerted a strong and significant effect on the explained variance in reported symptoms of ill health. However, with regard to the ill-health symptoms, the difference between the effects from the psychosocial work environment and the physical work environment was quite small. Additionally, the results showed that the perception of work safety climate was a strong predictor of the employees' perception of the physical work environment. The employees' perceptions of the physical work environment contributed a stronger direct effect on the employees' self-reported involvement in occupational accidents, than the employees' perception of the work safety climate. Perceptions of the psychosocial work environment did not contribute significantly to the measure of occupational accidents used in paper III.

The effect of the work safety climate, physical work environment, and psychosocial work environment on the different aspects of perceived health status varied quite considerably with respect to the work group. Generally, the results suggested that the included variables accounted for a small percentage of the total variance in the employees' self-reported involvement in occupational accidents across the different work groups (9.3% in the well-services group and 1.2% amongst crane and deck operators). The results also showed that perceptions of the physical and psychosocial work environment along with perceptions of the work safety climate accounted for a relatively large amount of the variance in the respondents' reported symptoms of ill health, such as musculoskeletal complaints, allergies and hearing difficulties. These variables accounted for 43.6% of the symptoms among the well services personnel, 16.6% amongst accommodation personnel, and 12.5% amongst the "other" work group. The results also suggested that perceptions of the work environment and the work safety climate generally explained more of the variance in the employees' perception of ill-health symptoms compared with their

perceptions of the general health status. The work safety climate exerted a strong influence upon the respondents' perception of their physical work environment conditions, a result that was consistent across the eight work groups studied in paper III. Between 9.5% and 33.0% of the variance in perceptions of the psychosocial work environment were accounted for by the physical work environment and the employees' perception of the work safety climate.

### **3.3.1 The main findings in paper III**

The results presented in paper III in this thesis can be summarised as follows:

- The perception of general health status was the strongest predictor of the overarching factor health, as one part of the estimated HSE concept.
- The dimensions used to account for the work safety climate were adequate descriptors of the overarching construct.
- The perception of HSE-related factors in the workplace varied according to work group.
- Increasing the specificity in the model also increased its explanatory power.
- Work safety climate was a strong contributory factor to explain the employees' perception of their physical work environment conditions.
- The work safety climate and the employees' perception of the work environment accounted for varying amounts of the variance in ill-health complaints in the different work groups

## **3.4 Summary of the results reported in paper IV**

### *MODELLING THE EFFECTS OF A LARGE-SCALE SAFETY CULTURE PROGRAMME: A COMBINED QUALITATIVE AND QUANTITATIVE APPROACH*

Paper IV explored the effects of a large-scale safety programme implemented by a Norwegian petroleum company using a combined quantitative and qualitative approach. Results from fieldwork studies and qualitative interviews were used to develop a hypothetical structural model, aiming to illustrate important effects of the safety programme in the organisation. The theoretical model was tested on data from a survey carried out amongst employees in the company.

Based on the qualitative analyses reported in paper IV, five theoretical domains were defined as important to incorporate into the hypothesised structural model. These were: 1)

participation in a two-day kick-off meeting, 2) effectiveness of programme implementation (i.e. the workers' perception of the implementation of the safety programme and their satisfaction with the programme), 3) employees' personal commitment to the programme (i.e. the degree to which the workers follow up their personal programme commitment), 4) safety behaviour change (i.e. the extent to which the workers feel that their safety behaviour has changed following the implementation of the safety programme), and 5) safety culture change (i.e. the degree to which workers agree that the safety programme has improved the company's safety culture).

The evaluations made by key personnel in the company supported the relevance of the theoretical domains developed as a result of the applied qualitative methodology. Separate exploratory factor analyses also revealed that the theoretical domains could be replicated by the data, thereby supporting the relevance of these domains to evaluate the adopted safety programme. Confirmatory factor analyses of the theoretical domains were conducted in a second step. The goodness of fit indices for these analyses indicated that the measurements fitted the data at hand satisfactorily.

The structural model was developed on the basis of results from the interviews, programme characteristics, and previous research. The safety programme was, in this study, characterised as an environmental factor that could facilitate change in the employees' work behaviour and in the organisation's safety culture. The theoretical basis and motivation behind the programme presupposed that the workers attending the programme had to find the activities meaningful for the programme to be effective. Effective implementation of the safety programme was also thought to increase the workers' commitment to the programme, which subsequently influenced changes in safety culture and safety behaviour.

Confirmatory factor analysis and SEM goodness of fit statistics indicated that the structural model fitted the data and had effective explanatory power. The tested model explained 62.1% of the variance in safety culture change and 47.1% in safety behaviour change. The tested model explained 11.9% of the variance in personal programme commitment and 1.4% of the variance in effectiveness of programme implementation. The fit indices for the model were considered satisfactory, and the tested model revealed no need for modifications based on residual statistics or the modification indices. However, the results showed that personal programme commitment exerted no significant

effects on safety culture change or safety behaviour change. These non-significant effects contrasted the results from the qualitative analyses; therefore, the model was modified and re-estimated.

In the modified model, personal programme commitment was treated as an antecedent instead of an outcome of effectiveness of programme implementation. The fit indices of the modified model were adequate, supporting the hypothesised influences. The final estimated model that was developed illustrated the significance of personal programme commitment and the effectiveness of programme implementation for the level of change regarding safety behaviour and safety culture. It was also found that participation in the two-day kick-off meeting had two positive and one negative (direct) path estimate.

### **3.4.1 The main results from paper IV**

- The associations between the latent and the manifest variables used in the hypothetical model were supported.
- The tested hypothetical model explained a large part of the variance in safety behaviour change and safety culture change.
- The tested hypothetical model also explained some of the variance in the employees' reported personal programme commitment and the effectiveness of programme implementation.
- Participation in the two-day kick-off had both positive and negative influences on personal programme commitment because of the high expectations developed among the workers.
- Safety behaviour change influenced safety culture change and vice versa.

## **3.5 Summary**

The main results of the present thesis that were summarized in the sections above can be encapsulated in the following conclusions.

### **3.5.1.1 Group differences in the HSE-reality**

Differences were identified between work groups in the onshore and offshore work environments (paper I) and onboard offshore oil installations (paper III). Work- and organisation-related variables had a different impact upon employee health perceptions based on occupational position in the organisational hierarchy. For instance, a larger amount of the variance in subjective health complaints were accounted for among well-

services personnel offshore (43.6%) than among maintenance workers (19.0%) in paper III. Hence, the results suggest that there exist different *sub-cultures/climates* in terms of the employees' perceptions of HSE-related variables.

These results suggest that HSE interventions should be targeted towards more specific groups in the organisational hierarchy. Different groups of workers face different organisational realities in terms of health, safety and environment factors, and these organisational realities needs to be taken into account. The assumption is that such a specification will improve the effectiveness of interventions, programmes, and practices related to the improvement of HSE. This was also shown in paper IV, where the implementation of a safety programme explained large amounts of the variance in the outcome variables, i.e. safety behaviour and safety culture change. The further implication is that appropriate changes in the social and physical environment will stimulate changes in individuals (e.g. by influencing behaviour, increased commitment to the organisation) and that these changes are essential for the effective implementation of interventions, programmes, and new practices.

#### **3.5.1.2 Employee age**

Older employees (i.e. over the age of 50) perceived aspects related to health, safety and environment differently from their younger counterparts. Older workers appeared to be more satisfied with their work environment and the work safety climate. However, the results reported in the present thesis also showed that the older workers reported a higher frequency of ill-health symptoms, and they also evaluated their general health status more negatively. These results are in line with other empirical research in the field. Research has shown that safety climate scores have tended to increase with age and that ageing is typically associated with decreases in health status.

Generally, the average age of employees in the Norwegian oil and gas industry has increased during the last decade, and the proportion of older workers will continue to increase in the years ahead. It can therefore be expected that there will also be an increase in the extent of exclusion, age-related health problems, and ailments due to long-term exposure to work. Research evidence also indicates that offshore employees are reluctant to relocate to a lowered-paid position onshore because this means reductions in the standard of living. The results presented in this work highlight the importance of implementing strategies to maintain and improve working conditions in order to increase

retention. The argument is that it would be valuable to find ways of conserving the knowledge of older workers and new forms of work organisation in which healthy work could be conducted.

### **3.5.1.3 The relationship between health safety and work environment**

The results presented in this thesis showed that work- and organisation-related variables accounted for varying amounts of the variance in employee health. A more complex model, i.e. taking the work group structure into account generally also had more predictive power. The results presented also showed that the work safety climate exerted a direct effect on the employees' perception of ill-health symptoms. Amounts of explained variance in the outcome measures (i.e. subjective health complaints and general health status) increased, as the specificity of the model increased again underlining the importance of using specified groups when studying the HSE culture/climate.

The employees working in the Norwegian oil and gas industry constitute a healthy work group, reflecting the high medical standards required for work in the oil and gas industry. In the present thesis it is argued that in order to examine the effect of work and organisational factors on outcome measures it is important to widen the measurement of employee health. Health can not only be investigated by focusing on one dimension (i.e. somatic symptoms) but must also include a wider specification of the social and mental aspects. This conclusion is further corroborated by results indicating that there is a gap between the employees' reporting of ill-health symptoms and their perception of the current general health status.

The results of the present thesis also argue that the specific relationship between the work safety climate, the work environment, and employee health ought to be further investigated. Rather than treating the HSE concept as a one-dimensional construct, reflecting one particular aspect of organisational functioning, the results of the present thesis indicate that the concepts of health, safety and work environment needs to be studied separately in order to understand the dynamic relationship between them better. The next section of this thesis will discuss the specific research findings in more detail and more related to existing research and theoretical approaches.

## 4 General discussion

The main purposes of this thesis were to explore the relationships between health, safety and the (work) environment within the Norwegian Petroleum Industry. More specifically, the aims addressed in papers I to III sought to examine the predictive power of different work and organisational variables (e.g. the work safety climate, the psychosocial work environment) on the respondents' reporting of ill-health symptoms and on their perception of their current general health status. Paper III expanded the relationship between health, safety and the work environment by also including the employees' self-reported involvement in occupational incidents and accidents. Paper IV had a somewhat alternate focus, as it evaluated the effect of a large-scale safety programme with regard to employee safety behaviour change and organisational safety culture change. These objectives were examined within the framework of the composite concept of health, safety and (work) environment (HSE) culture/climate. They were also examined by using different samples of workers in the Norwegian oil and gas industry (e.g. onshore and offshore), collected at different points in time (i.e. between 2001 and 2005/2006).

The composite HSE concept, as it is used in this thesis, was measured by the employees' subjective health status (e.g. musculoskeletal complaints, allergies, psychological complaints, and general health status), perceptions of the work environment (i.e. physical and psychosocial aspects), and the work safety climate (e.g. perceptions of management's commitment to safety). Health perceptions and self-reported involvement in occupational accidents were treated as individual-level outcome variables, whereas the employees' perceptions of the physical and psychosocial work environment and their evaluations of the work safety climate were treated as perceptions of work- and organisation-level variables. The concept of an "organisation" has in the present thesis been used to describe an offshore oil installation in papers II and III. In papers I and IV, it was used to describe the overall enterprise in which the study was conducted.

The specific research findings from the four empirical studies that are a part of this thesis are treated in more specific detail in the included papers. The following general discussion is broader, and attempts to elaborate the main findings in a wider practical and theoretical context, e.g. the use of HSE culture/climate in the oil and gas industry and the challenges associated with the concept. The following discussion addresses group differences in HSE,

the relationship between employee health and the work safety climate, as well as the relationship between work, organisation, and employee health. Additionally, the concept of health relative to the oil and gas industry is discussed in greater detail. This general discussion also addresses the specific meaning inherent in the overall HSE culture/climate concept on the basis of the results reported in this thesis. Methodological concerns and limitations are also treated as part of this general discussion. Finally, the implications of the reported results are discussed, and suggestions for further research in the field of HSE are provided.

#### **4.1 The HSE concept**

The health, safety and environment concept deals with the complex interaction between technology, organisations and people. The culture/climate concept has been incorporated to explain the development of, and changes in the HSE-status in the Norwegian oil and gas industry. The inclusion of the culture/climate concepts into the overall notion of HSE, has led to an increased emphasis on the dynamic interactions between the three separate parts, and also highlighted the necessary interaction between all levels in the organisational hierarchy as a prerequisite for satisfactory work with issues related to employee health, safety, and the work environment. Hence, inherent in the HSE-culture/climate construct is recognition of the fact that health, safety and environment cannot be seen as detached from each other. It is also recognition of the balance that needs to be upheld between individual and organisational responsibility for HSE at work. However, although the importance of balancing the separate parts has been highlighted, the relationships between health, safety, and the environment has seldom been fully accounted for in the research literature (Mearns et al., 2008).

The three specific dimensions of HSE (i.e. health, safety and environment) are often treated as one overarching concept, measuring one specific aspect of organisational functioning. Treating HSE as a one-dimensional concept may lead to erroneous results and conclusions. For instance, it is difficult to assess the relative importance of health, safety, or the environment for the individual worker in the cognitive appraisal process, in which employees evaluate which values they perceive as being most important in the work context. This implies that the HSE culture/climate should perhaps be treated as a “composite” concept, consisting of three separate, albeit related, parts that are of relevance to the overall working situation.

It might also be argued that the health, safety and work environment concepts represent partly incommensurable concepts that require unique attention, measurement, and interpretation.



The argument is that employee perception of the work safety climate and the physical and psychosocial work environment are more directly linked to the individual's work role and his or her perception of the workplace. These dimensions predominantly concern the individual's perceptions, beliefs, or attitudes related to one specific, albeit important, domain i.e. features of the work environment and characteristics of the organisation and the workplace. The health concept, on the other hand, is more directly related to the individual and his or her level of functioning and well-being. As stated previously, individual health perceptions are not only dependent on the work situation, but also on important facets of life such as family and leisure time. It could therefore be argued that the concept of health encompasses a broader scope, i.e. it influences several important areas of individual functioning, than the work safety climate and the work environment dimensions inherent in the composite notion of the HSE culture/climate.

It can also be argued that the HSE culture/climate concept, as used in the oil and gas industry in practice, has been treated as an equivalent to the notion of safety culture/climate. For instance, the questionnaire that has been used as part of the Trends in Risk Level (TRL) project has been criticised for adopting a far too narrow individualistic view of safety and the factors that are believed to influence safety at work. The criticism states that the questionnaire used incorporates few questions that deal with employee interaction or teamwork, thereby making it difficult to detect the cultural aspects of safety, given the assumption that a culture develops over time, and within a "stable" group of employees (Schein, 1990). Also, a narrow conceptualisation of employee health is included in the TRL questionnaire (i.e. symptoms of ill health experienced during the last three months), thereby making it difficult to detect and evaluate the dimensionality of health that should be included in the overarching notion of HSE.

The approach adopted in the current thesis is that the use of HSE culture/climate warrants a specific investigation into its separate dimensions. Similar suggestions have been voiced in previous research. Gardner (2003), for instance, argued that employee health has been somewhat "neglected" within the offshore oil and gas industry, implying that issues related to employee health and well-being have received relatively little attention in empirical research within the international oil and gas industry. Papers I, II, and III sought to examine employee health and perceptions of work- and organisation-related factors more specifically.

## **4.2 Work groups**

A work group generally consists of two or more individuals assigned to a permanent team in the organisational hierarchy, and is based on the special skills of the individual worker (e.g. crane and deck workers, accommodation personnel). The work group members each have specific roles in the organisational hierarchy, and they perform interdependent tasks. Different work groups are coordinated within the organisation to achieve a common goal or common sets of goals (Anderson & West, 1998). In the present context, it is also important to note that the work groups exist within high reliability organisations (e.g. an offshore oil and gas installation), defined as organisations that exist in hazardous environments where the consequences of errors are high but the occurrence of errors is extremely low (Baker, Day, & Salas, 2006).

In the present thesis, specific occupational groups were used to explore employees' perception of work and organisational factors, and subjective health status as part of papers I and III. The results suggested that perceptions of health and work- and organisation-related variables were dependent on the type of occupational position, i.e. the work group in the organisational hierarchy. For instance, the results in paper I indicated that engineers working in an onshore work environment rated their physiological health status as significantly better when compared with employees working as pipe or steel workers in the onshore context. Paper III also showed that the effect of the employees' perception of the physical and psychosocial work environment and their perceptions of the work safety climate affected employee self-reported health status differently depending on different work groups. The results in this thesis are therefore in line with previous studies showing that different occupational positions in the organisational hierarchy affect how the employees perceive their work environment and their organisations, i.e. different job types vary in work demands, perceived control, and where in the organisation they are located. These different work conditions will exert different impacts on worker health and well-being (Marklund et al., 2008), which were also suggested by the results in the present thesis. For instance, in paper III, the results indicated that the employees within the well-services group appeared to be most dissatisfied with their physical work environment when compared with work groups such as accommodation and construction personnel. These differences might be attributed to different physical work environment conditions, i.e. well-services workers are more exposed to hazards such as chemicals, noise, harsh weather conditions, and vibrations.

#### **4.2.1.1 The work group and the individual worker**

Employees do not respond to their work environment directly, but must first perceive and interpret their environmental surroundings. Their subjective assessment and interpretations of the work environment are related to their subjective health and well-being, and are believed to be mediated through the process of coping, i.e. different ways of handling stress (Arezes & Miguel, 2008; Carr, Schmidt, Ford, & Deshon, 2003; Conway et al., 2008; Schulte, Ostroff, Shmulyian, & Kinicki, 2009; Smith et al., 2006). The degree to which a person appraises the work environment as being beneficial versus detrimental to their health and well-being determines their attitudes towards as well as their reactions to the work context and the work organisation (James & James, 1989; Lazarus, 1999).

For individuals working in an organisation, the most prominent social context is the immediate work group. Research has, for instance, suggested that individual employees feel more committed to their specific work group than to the organisation as a whole (Becker, 1992). Furthermore, Geller, Roberts, and Gilmore (1996) have indicated that a sense of belongingness to a work group as well as perceptions of personal control over the work tasks predicted the workers' propensity to care actively for co-workers' safety as well as employees' propensity to comply with safety rules (Geller, Roberts, & Gilmore, 1996; Simard & Marchand, 1995). Additionally, members of the same work group are also exposed to the same policies, procedures, leaders, and contextual characteristics. These factors are also thought to contribute to shared information and common perceptions regarding the work environment and the organisation within a specific work group.

The immediate work group has also been found to be important in the individual's socialisation process into the organisation. It is through the interactions with similar others in a work group that individual employees learn the behaviours and attitudes that are accepted, encouraged, and rewarded in the organisation. This means that the work group members shape each other's expectancies regarding organisational events, and also influence the employees' perceptions regarding which events or situations are evaluated as stress inducing and threatening to important personal values (e.g. subjective health, well-being, and safety) in the context of work (Mullen, 2004). Previous research has demonstrated that a significant amount of perception of job demands and job control is dependent on work group belongingness. This was shown in a study exploring the extent to which negative health-related outcomes were associated with differences between work groups and with differences

between individuals within work groups using the demand–control model (Van Yperen et al., 2000). The results from this study showed that employees within the same work group agreed to a certain extent about the “heaviness” of the workload, and also about the degree of control over the job tasks. Similarly, previous research has suggested that members of specific work groups are in agreement with respect to different perceptions concerning the overall safety status within the organisation (Mearns et al., 1998). These studies are in line with the results presented in this thesis, indicating that workers belonging to different work groups in the offshore and onshore environments also perceived aspects related to health, safety and the work environment differently based on their specific work group belongingness in the organisational hierarchy (i.e. in paper I and paper III).

A more theoretically based explanation for the identified differences in perceptions of HSE-related variables across work groups can be found in the social comparison theory (Festinger, 1954). The original aim of this theory was to explain why members of specific groups tend to be similar (e.g. in attitudes and perceptions). The social comparison theory argues that in Western cultures individuals are often driven to improve their performance continually. During this process, individuals seek out similar others with whom to compare themselves (Festinger, 1954). This implies that workers in an organisation, through the process of comparison, seek to test the “subjective validity” of their beliefs about themselves and the world around them. The general assumption is that beliefs are seen as valid and appropriate when they are shared by similar others, i.e. by the members of an appropriate reference group. Implicit in the social comparison theory is also an assumption that individuals learn about themselves, assess themselves, and decides on their reactions to events by comparing with “relevant” other people. In an organisational context, it is assumed that the relevant other people are the employees’ co-workers. Hence, according to the social comparison theory, the team members will observe each other’s perceptions and reactions and use these as a frame of reference for attitudes and behaviours in the organisational context. Employee interaction and comparison with similar others in the context of work may contribute to the development of shared climate perceptions (e.g. of the work environment and the work safety climate). These shared climate perceptions are thought to be especially valuable in situations where it is unclear which performance or which behaviour should be prioritised (Zohar et al., 2008). It is also assumed that these shared perceptions will influence outcome variables such as employee health and well-being and also determine the appropriate actions toward the work environment.

Related to the mentioned argument concerning social comparisons and identification with the work group, Brown and Leigh (1996) have suggested that work group culture/climate reflects a sense-making process by which group members collectively understand and interpret their expectations about collective events (Brown et al., 1996). This implies that the interactions between the members of a work group influence whether an event or condition in the work environment should be considered a stressor, and by extension what level of risk within the work environment is perceived as tolerable (Bliese & Jex, 2002). Employees look to similar others, observe their behaviour in relation to new and unexpected events, and are motivated to exhibit the same behaviour as the rest of the group members. This is also a central assumption in the transactional model of psychological stress (Lazarus et al., 1984). Upon the encounter of a new and unexpected event, the most reasonable thing for the individual employee to do is to direct his or her attention towards the behaviour of similar others, i.e. the co-workers in the work group. The reaction of the similar others will, by the processes of observation and comparison, influence the degree to which an event is perceived as threatening or stressful by the individual, and hence also determine whether the event or situation has harmful effects on employee health (Lazarus, 1999). It is also assumed that comparison with similar others will inform the individual about what kind of behaviour that is appropriate in a specific situation. For instance, the results reported in paper I of this thesis suggested that the variation *within* the onshore and offshore group (i.e. the standard deviations) with regard to health and work perceptions were more heterogeneous than the variations found between the respective groups.

#### **4.2.1.2 Different organisational realities**

Members of different work groups respond differently to different organisational characteristics, as was suggested in the results of papers I and III, where it was shown for instance that employee' health perceptions vary according to work group belongingness. On the basis of these results, it can be argued that different work groups in an organisation encounter different degrees of variation and exposure to physical, psychosocial, and organisational stressors in their daily work activities. For instance, the results reported in paper III showed that the interaction between organisational (i.e. the work safety climate), physical (i.e. the physical work environment), and psychosocial (i.e. the psychosocial work environment) factors affected the employees' self-reported health status and involvement in occupational accidents differently depending on work group belongingness. It can therefore be argued that different organisational, psychosocial, and physical work environments exist

for each specific work group, meaning that each group within an organisation (e.g. an offshore oil installation) in the industry is faced with its own *organisational reality*.

The organisational reality for each work group will vary as a result of membership of a specific work group, and it is assumed that this reality will influence group members' perceptions of the working environment and the working context (DeJoy et al., 2004; Gillen et al., 2002; Young & Parker, 1999). For instance, relative to the oil and gas industry, it is acknowledged that work operations in onshore and offshore environments differ in work tasks' demands and also with regard to the level of risk associated with the different work tasks. These are factors that in turn are thought to influence employee health and well-being in the context of work (Cooper, 1998). It can be argued that the observed work group differences with regard to the workers' perceptions of health, safety, and work environment aspects, as identified in papers I and III, partly can be attributed to different organisational realities. Research has for instance indicated that the individual worker's immediate work group is one of the best predictors of an individual's perceptions of and attitudes towards the working conditions (Bliese et al., 2002; Parker et al., 2003). Research has also demonstrated a link between group cohesion, i.e. the desire to identify with and be an accepted member of a group, and the propensity to comply with safety rules and regulations in the workplace (Simard et al., 1995; Zacharatos et al., 2005). It has been argued that group members exert both informational and social influences on each other, informing about the true priority placed on health and safety, and also with regard to which behaviours are viewed as acceptable within the context of work. These influences, along with similarities in the physical and psychosocial work environments, are thought to contribute to shared perceptions of the work safety climate among the members of a work group (Young et al., 1999). In a similar vein, research has indicated that a work group may enhance safety at work, because the work group provides those people who are familiar with the situation with greater opportunities for control over the environment (Zacharatos et al., 2005).

The above line of reasoning is in accordance with previous empirical work within the oil and gas industry. For instance, Mearns and colleagues (2001) argued that differences between disparate occupational groups offshore stem from "different worlds of risk", meaning that employees in different work groups view risk and safety differently based on the kind of work they do. These different worlds of risk are thought to develop as a result of, for instance, demographic factors such as age, experience, occupational and situational factors, e.g. the

physical working conditions and work pressure (Mearns et al., 2001). Numerous studies have supported the assumption that the perceptions of the work safety climate will vary as a result of different work groups in an organisation, i.e. that different worlds of risk exist (Flin et al., 2000; Guldenmund, 2000; Harvey et al., 2002; Lee, 1998; McDonald, Corrigan, Daly, & Cromie, 2000). However, it has also been argued that differences in the perception of the work safety climate among groups can lead to competing priorities, miscommunication, and ultimately the lack of a cohesive safety climate in the organisation as a whole, i.e. the members of a work group do not necessarily share common safety attitudes and perceptions (Findley et al., 2007).

Within an organisation, members of different work groups interact with each other to produce a shared interpretation of their social and physical surroundings, thus contributing to the development of their organisational reality (Schneider & Reichers, 1983). Through interpersonal interactions in the work group, members are driven to achieve and maintain a homeostatic balance with their work environment, striving to accomplish a common goal. As a result of interpersonal interactions within the work group and interactions with the work group's surroundings, it is assumed that different norms and rules of behaviour will emerge, guiding the employees within the work groups. Subsequently, the members belonging to a specific work group will be rewarded for their compliance with these norms and rules of behaviour, and thus the norms and rules developed in the work group will influence workplace safety (Bradley, 1995; Watson, Scott, Bishop, & Turnbeaugh, 2005; Zohar et al., 2005). Furthermore, it can be argued that the shared work group perceptual, behavioural, and motivational responses to the environment will contribute to the formation of unique climate perceptions at the sub-unit level of the organisation, i.e. at the work group level (Dragoni, 2005; Hemmelgarn, Glisson, & Dukes, 2001; Zohar et al., 2005). This means that each work group within an organisation will be characterised by a unique culture/climate that consists of the work group members' shared perception of and attitudes towards the organisation as a whole, and also to specific facets of organisational functioning (e.g. health, environment, and safety). This unique climate will in turn exert different effects on individual employees' health perceptions and also contribute to the frequency of occupational accidents.

Based on the reasoning above, it can perhaps be argued that the observed differences between the work groups shown in paper III are indicative of the existence of different workplace cultures/climates, or more specifically different HSE cultures/climates. According to previous

research, an organisational climate is the internal characteristics that distinguish one organisation from another (Piiirainen et al., 2003). In the present context, it is argued that the work group HSE climate is the internal group characteristics that distinguish the work groups from each other in an organisation (i.e. onboard an offshore oil and gas installation or in an enterprise).

It has been argued that, instead of viewing organisations as unitary entities with an overall culture or climate for HSE with different sub-cultures/climates, organisations' might instead be described in terms of differentiation, conflicts over resources, and the exercise of power (Antonsen, 2009). In an organisation the division of labour inevitably creates power differences between the varying work groups because various tasks and activities are not equally critical to an organisation's survival. The implication of this argumentation is that differences in perceptions of HSE-related variables, as demonstrated in the present work, might develop as a result of a different "status" in the offshore oil and gas installation hierarchy, and hence also be due to different degrees of power in the organisation. The argument made is that work groups with a higher status in the offshore hierarchy also have a greater degree of power, i.e. in terms of influencing the overall HSE culture/climate onboard the installation. The work groups lower in rank, according to this reasoning, have less power and authority and hence are also less able to exert an influence on the HSE situation onboard the platform. It can also be argued that the status of a work group in an organisational environment will increase the value of the group and influence group members to identify more strongly with the group and increase the group members' need to be associated with it. Anecdotal evidence from the Norwegian oil and gas industry, for instance, indicates that drilling operators enjoy a higher social status onboard the installation compared with the other work groups within the offshore hierarchy, based on the assumption that these employees traditionally have the most demanding physical working conditions on a platform, and also because drilling operations represent the starting point for all the activity on the shelf (Parkes et al., 2000; Ryggvik et al., 1997). The results in paper III of this thesis support the above reasoning suggesting that drilling personnel were most satisfied with the psychosocial work environment and the work safety climate onboard the installation compared with the other work groups (e.g. construction, crane/deck, and accommodation personnel).

Related to the argumentation above, group members will aim to achieve certain objectives through collective control over work tasks. In this context, employee attitudes and perceptions



regarding the level of HSE aspects are context dependent, and, since the context that the work group operates within is different from that of the others, the result will be differences between work groups regarding climate perceptions. Shared practices and norms may be determined by the conditions and realities that the workers face on a day-to-day basis and these may therefore influence the individual's perception of the work safety climate, health, and work environment in different ways (Hemmelgarn et al., 2001).

#### **4.2.1.3 Summary**

The discussion related to differences between the work groups indicates that the development of a satisfactory HSE culture/climate for HSE work may be strongly related to employee interaction on a more localised level in the organisation. The implication of the reported results is therefore that HSE culture/climate interventions might be more effectively implemented if their focus is directed towards smaller sub-systems within the overall organisation. First and foremost, this is an appropriate strategy to obtain a more differentiated view of actual problems within the organisation, but it is also important to involve the workers within the different departments. The assumption is that the development of a positive safety culture/climate for HSE requires employee involvement and commitment within all the organisational sub-units. It is reasonable to assume that employees will be more committed to HSE interventions if they perceive that these are targeted towards problems deemed important to them and their co-workers in their daily work activities.

### **4.3 Age and work in the oil and gas industry**

Employee perceptions of HSE-related variables, such as the perception of subjective health status, psychosocial work environment factors, and the work safety climate, were examined in papers I to III by taking employee age into account. Generally, the results suggested that older employees (over the age of 50) reported a higher frequency of ill-health symptoms, and they appeared to evaluate their general health status in a more negative manner when compared with the younger employees (as shown in papers I-III). For instance, in paper II, the results showed that employees in the age range between 50 and 67 reported the highest frequency of musculoskeletal complaints. These employees also perceived more limitations in their daily work activities offshore as a consequence of the reported health impairments. Similarly, the results in paper I suggested that the interaction between employee age and seniority in the enterprise among the offshore employees influenced their perceptions of physiological health status (paper I).

With regard to the included work- and organisational-related variables used in papers II and III, the results suggested that older employees had a more favourable view of the work safety climate, and they also appeared to be more satisfied with the psychosocial and physical working conditions when compared with their younger colleagues. The highest self-reported accident frequency was found in the group consisting of employees below 30 years of age, and the results in paper III indicate that involvement in occupational accidents decreases with increasing age. Also, the results reported in paper II showed that the age groups included in the structural equation modelling contributed more strongly to the respondents' self-reported health complaints (e.g. musculoskeletal complaints, allergies, impaired hearing) than their perception of the work safety climate.

The results of the present thesis are in line with similar empirical findings within the offshore oil and gas industry. For instance, in a study including UK oil and gas personnel (N=1867) measuring employee perceptions of the work environment (e.g. physical stressors, job demands, job control, skill discretion, supervisor support, and safety perceptions) related to working time arrangements and "objective" work environments (i.e. onshore and offshore), it was shown that a higher age was associated with more positive perceptions. Older employees reported a lower level of exposure to physical stressors, greater skill discretion and job control, more support from supervisors, and more positive safety perceptions (Parkes, 2003). Furthermore, research suggests that older employees are more prone to experiencing health complaints caused by work because these workers may find it more difficult to adapt to changing and unstable work demands, which are characteristics of today's workplaces (Conway et al., 2008). With regard to self-reported accident involvement, the results reported in paper III appear to be in line with previous research. For instance, in a study examining age-related accident risk among Swedish male mine workers, the results showed that older workers (i.e. over the age of 45) reported fewer occupational accidents when compared with their younger counterparts (Laflamme, Menckel, & Lundholm, 1995).

#### **4.3.1.1 The habituation effect**

The reported age group difference found in relation to the perception of the work environment, risk, and the work safety climate could perhaps be found in the "habituation effect", i.e. the psychological process in humans in which there is a decrease in the psychological and behavioural response to a stimulus after repeated exposure to that stimulus over the duration of time. Habituation to stressful stimuli can be important because it is associated with reduced stress and improved functioning among individuals. In the present

context, it might be argued that older workers also have longer seniority in the industry, and hence have learnt or adjusted their psychological and behavioural responses to the environment in such a way as to reduce the stress and perceived risks associated with the work tasks.

The habituation argument can be related to research performed by Glendon and McKenna (1995). They argued that a certain level of risk is inherent in the job, and also that an individual employee must tolerate a certain level of risk in order to maintain his or her employment (Glendon & McKenna, 1995). If the individual employee does not tolerate the inherent level of risk, the result will be an imbalance between the subjective values of the individual and the resources offered by the environment, i.e. a mismatch between the person and his or her environment. This line of argumentation can be viewed in the context of the person–environment fit theory (French, Caplan, & Harrison, 1982). The person–environment fit theory argues that it is the interaction between the person and the work environment that contributes to the occurrence of perceived stress and performance-related behaviours (Sherry, 1991). Previous research has suggested that such a mismatch between the person and his or her environment will have deteriorating effects on employee health and well-being and result in consequences such as decreased productivity, increased absenteeism, and burn-out (Caplan, 1987). It has also been argued that a mismatch between the person and the environment will increase the employees' turnover intentions and hence motivate the workers to change jobs in order to decrease the negative emotions and consequences associated with the mismatch.

Related to the results reported in this thesis, it can be argued that those older employee's who have longer seniority in the industry also have a greater acceptance of the level of risk inherent in the job. This implies that a habituation effect has occurred and that the match between the person and his or her environment is greater than the match between the person and the environment for younger employees. The implication of this argument is that the industry has retained a certain group of people, e.g. those who have adapted quite satisfactorily to the offshore work environment and the associated physical and mental demands placed on them. This line of argumentation is supported by research showing that employees who do not tolerate the level of risk inherent in a job will change jobs within a period of six years (Osmotherly & Attia, 2006), further supporting the argument that only those workers who tolerate the strenuous demands associated with offshore work will be retained in the industry. This argumentation underlines that there is a degree of self-selection

into work within the oil and gas industry in terms of intellectual demands, physical and mental health, and the possession of some adaptive personality traits (Punnett et al., 2004). Parkes (1998), for instance, showed that offshore personnel are significantly biased towards presenting a stable extravert personality characteristic, which is usually associated with above average mental health (Parkes, 1998).

Also, a kind of “familiarity” effect might be present, i.e. older employees have been in the industry for the longest period of time and are therefore more familiar with the risks, demands, and culture in the offshore oil and gas industry. Consequently, these factors will not exert a negative influence on their level of subjective health and well-being in the work context. A possible implication is that these employees also experience a greater degree of control over the sources of risk in the working environment. This in turn can be related to the control concept as postulated in the demand–control–support (D-C-S) model, described in the introductory section of this thesis (Johnson et al., 1988; Karasek, 1979). According to the D–C–S model, perception of control refers to the perceived ability to control the work environment and the outcomes of work activities. Furthermore, stress arises when the demands imposed by the environment exceed the employees’ ability to cope with or control them (Teasdale, 2006). In the present context, it can be argued that the increased experience posited by older workers makes them more aware of the physical hazards in the work environment and they are also able to exert control over them, i.e. they experience influence over the development of organisational safety practices and procedures. This, in turn, might lead to increased satisfaction with the physical work environment and the work safety climate as shown in the results in paper II and III in this thesis.

The concept of familiarity with and perception of hazards should, according to the discussion above, have a negative relation with workplace accidents and injuries. The results as reported in paper III show that it was the youngest employees (i.e. employees below the age of 30) who reported that they had experienced the highest frequency of occupational accidents during the last year. One possible reason for this finding could be that the younger employees lack experience in their work, which in turn might contribute to an increased rate of occupational accidents. In addition, younger employees, due to a lack of experience, may not necessarily be aware of the risks they face, and may not necessarily know how to protect themselves. This can be related to existing research showing that novelty is a significant factor influencing the perception of risk (Brun, 1994). Similarly, according to traditional

psychological stress theories (Lazarus, 1966; Selye, 1956), it is also the encounter with a new and unfamiliar event that will increase the stress experienced by the individual. The implication is that if the hazard is poorly understood and unfamiliar, the perception of risk and the stress associated with it will be enlarged. In this situation, it is also likely that the increased perception of risk will contribute to a more negative perception of the work safety climate. This argument supports the finding that younger employees experience risks at work as being more dangerous compared with older employees due to the fact that these workers have less experience or familiarity with their job, which in turn also makes them more prone to experiencing occupational accidents.

#### **4.3.1.2 Summary**

In most industrialised countries, there is a need to understand better the way in which ageing as an individual and as a work factor interacts and affects individual psychological and physical capabilities. Older workers are considered a resource both for individual enterprises and for society as a whole. Since deciding to adopt the agreement for a more inclusive workplace (IA-avtalen) in 2001, senior policy has been an important issue for many employers. The aim is to accommodate the activities that try to attract, develop, and retain good senior staff and their expertise for the benefit of the business, the individual, and society as a whole. The implication of the results reported in the present thesis is the necessity for developing initiatives aimed towards reducing the effect of a lowered health status and make sure that older employees are able to utilise their experience and their resources more effectively.

### ***4.4 The relationship between work- and organisation-related variables and self-reported health complaints***

Papers I to III examined the relationship between psychosocial, physical, and organisational-level antecedents for employee perception of ill-health effects. Generally, the results showed varying degrees of variance in the outcome measures (i.e. subjective health complaints) explained by these antecedent factors. For instance, the results reported in paper I, which examined the effects of work- and organisation-related variables upon the employees' self-reported physical and psychological health complaints, showed a low degree of explained variance. The results also showed that the included variables primarily explained a larger amount of the variance in onshore workers' health perceptions compared with the offshore workers' health perceptions. Paper II directed a more specific focus towards employees working offshore in the Norwegian oil and gas industry. As in paper I, the results showed that

a low degree of variance could be accounted for in the outcome measures. Paper III employed a more specific, complex model to explain the variance in self-reported health status across different work groups. The results from this paper showed that the physical and the psychosocial work environment along with the work safety climate accounted for approximately 20 per cent of the variance in self-reported symptoms of ill health. However, the model used in paper III appeared to be better at predicting variance in outcome measures in the separate work groups.

#### **4.4.1.1 The relationship between the work safety climate and employee health**

According to Seo (2005), the work safety climate influences safety performance through three different paths simultaneously. The first path is an indirect influence. This means that the safety climate influences safety performance through other mediating factors such as perceived work pressure, perceived risk, and perceived barriers. The second part, as postulated by Seo (2005), states that the safety climate influences performance directly by influencing the safety barriers that affect unsafe work behaviours. Research has shown that scepticism about the efficacy of safety measures and the perceived inconvenience of complying with safety procedures constitute a large part of the perceived safety barriers (Brown et al., 2000). The third identified path also states that the work safety climate influences performance directly by exerting a direct influence on the workers' unsafe work behaviours.

According to the results in paper II and paper III in the present thesis, it might be argued that the work safety climate also influences the employees' ill-health perceptions through three paths simultaneously. The results in paper III suggested that the work safety climate influenced employee reports of subjective health complaints indirectly through the direct influence on the employees' perceptions of the physical and the psychosocial work environment. The employees' perceptions of the physical and the psychosocial work environment both exerted a direct significant and positive effect on employee perceptions of symptoms of ill health (e.g. musculoskeletal complaints). The results reported in paper III also showed that employees' perception of the work safety climate had a direct influence on self-reported involvement in occupational accidents. It has been argued that human factors, such as employee behaviour, are an important factor in critical incidents, including industrial accidents. Hence, it can be argued that the work safety climate influences behaviour directly through its direct effect on self-reported accidents as shown in paper III in this thesis. The results reported in paper II of this thesis suggested that the workers' perception of the work

safety climate in the sample drawn in 2001 and in 2003 exerted a significant albeit weak direct effect upon the employees' perception of their subjective health status. Furthermore, through self-reported health status, the included work- and organisation-related variables exerted a strong effect on the employees' perception of limitations in daily work activities. Employee reports of limitations in daily work activities vis-à-vis the reported health impairments might in the present context be conceptualised as the behavioural response to perception of ill health.

#### **4.4.1.2 The work environment and employee health**

A "comfortable" work environment has been defined as one in which employees are psychologically safe, and where the organisation has a strong and visible commitment to employee health and safety. Research has suggested that the workers' perception of work as meaningful and "comfortable" is significantly related to an increased safety performance, reduced accident frequency, and positive effects on employee health and well-being (Bongers et al., 1993; Brown et al., 1996; deJonge et al., 2000a; Gyekye et al., 2005; Hofmann et al., 1996; Houtman et al., 1994; Karasek et al., 1990; Lundstrom et al., 2002; Seo, 2005; Siu et al., 2004). In the present work, employees' perception of the work environment was defined in terms of latent dimensions measuring both psychosocial (e.g. support from the closest supervisor and the perceived control over work) and physical aspects (e.g. noise, lighting conditions) related to work in the Norwegian oil and gas industry.

It is generally recognised that the dynamic interaction between physical, psychosocial, and organisational factors and practices affects employee health and well-being at work (Carayon et al., 2000; Darr et al., 2008; Lund et al., 2005; Parkes, Farmer, & Carnell, 2005). In the present studies, however, little of the variance in the outcome measures is accounted for. In previous studies it has been suggested that the proportion of variance in outcome measures accounted for by workplace factors tends to be quite modest (Shannon et al., 2001). This was particularly the case in paper I, where the included psychosocial work- and organisation-related variables accounted for a small percentage of offshore and onshore employees' perceptions of their physical and psychological health complaints. Also, in paper II, the results showed that work- and organisation-related variables accounted for a small amount of the variance in the respondents' health perceptions. The results in both of these papers indicated that the workers generally perceived the psychosocial, physical, and organisational related aspects in a positive manner, suggesting that a satisfactory level of person–environment fit had been obtained. However, it is not possible to exclude the possibility that

employees who consider their health as less satisfactory, or have fallen ill due to job-related factors, may have left their job in the oil and gas industry, meaning that only those who are physically and mentally healthy are retained. The results can therefore be interpreted in the light of the “survivor” effect, causing a bias in the estimates of the work and health relationship (Siebert, Rothenbacher, Daniel, & Brenner, 2001). The survivor effect describes a continuing selection process, i.e. those who remain employed tend to be healthier than those who leave. It has been assumed that this phenomenon is particularly present in physically demanding jobs such as the construction industry and work within the offshore oil and gas industry (Taimela et al., 2007; Siebert et al., 2001; Parkes, 1998).

It has been argued that excessive exposure to physical work environment factors and resulting ill health manifest stronger and more clear-cut exposure–response relationships compared with the exposure to psychosocial work environment factors (Rugulies et al., 2004). It has also been suggested that physical work environment factors are more important in the early stages of work-related disease development, whereas psychosocial factors play a more prominent role in later stages of disease development (Tveito, Hysing, & Eriksen, 2004). Hence, as an explanation for the low amount of variance accounted for in paper I, it might be argued that physical workplace factors show more short-term effects upon employee ill health (e.g. occupational injuries/diseases) while psychosocial factors exert more long-term ill health effects (e.g. emotional exhaustion, depression), which was not examined in the paper.

Paper III employed a more specific and complex model to account for the relationship between work and health, which included psychosocial and physical work environment factors as separate dimensions influencing the employees’ health perceptions. The results showed that psychosocial work environment factors (e.g. the perception of control) had a strong and significant influence on the employees’ perceived general health status, while physical work environment factors exerted a stronger influence on the employees’ perceptions of *symptoms* of ill health (e.g. musculoskeletal complaints, allergic reactions). In this thesis, subjective general health status was depicted as a summary statement incorporating the biological, social, physical, and psychological dimensions of human health. Due to these results, it might be assumed that the results are in line with those of Rugulies and colleagues (2004), showing that exposure to physical work environment stressors exhibits stronger and more “clear-cut” responses in terms of an increased perception of ill-health symptoms.



Based on the results reported in paper III and the argumentation presented in the previous sections, it can perhaps be argued that the employee perceptions of psychosocial work environment factors represent an aspect of *employee health*. This is based on the assumption that perceptions of the psychosocial work environment are related to perception of psychological well-being at work, and perhaps also generally, i.e. beyond the working context. Accordingly, psychosocial workplace variables will be broader in scope compared with the physiological work environment factors and thereby also influence the broader conceptualisation of the respondent's health status. It might also be argued that discontentment with the psychosocial work environment represents a lack of one of the basic rewards associated with work, as described by the effort–reward imbalance model (Siegrist & Peter, 1996), namely the experience of being part of a significant social group. Accordingly, it can be argued that aspects related to the psychosocial work environment and the workers' perception of general health status are measured at the same level, because they both embody a broader perception of a person's health and well-being, i.e. the psychological and social factors associated with work are more far reaching than self-reported symptoms of ill health. This line of argumentation is further underlined by the results reported in paper III, which showed a high and significant correlation between the health concept and the work environment concept included in the composite concept of HSE. The factor that was most descriptive of the health concept in the context of paper III was the employees' perceptions of their general health status, while the work environment concept primarily consisted of dimensions measuring the psychosocial work environment and included dimensions such as the perception of support in the work environment and the perception of control over the work tasks.

A point that warrants attention is the validity of the conclusions related to the relationship between the physical and psychosocial work environments and employee health, regarding the use of cross-sectional designs. The cross-sectional design has been widely applied to evaluate the association between (particularly) psychosocial work factors and occupational ill health. However, these research designs have been criticised because of their limited ability to establish causal relationships. The study participants are often asked to report how they currently experience their work situation, and within the same questionnaire also asked to report their experience with symptoms of ill health in retrospect (Davis et al., 2000). In the papers included in the current thesis, for instance, the recall period varied from 30 days (paper I) to 3 months (papers II and III). This implies that exposure is measured after the experienced

outcome, and may preclude a real evaluation of the relationship between work environment variables and the resulting ill-health effects. The possibility that the relationship may be reversed cannot be excluded, i.e. that employee health perceptions influence the respondents' perception of the physical and the psychosocial work environment.

#### **4.4.1.3 The work safety climate and perceptions of the working environment**

The safety status of a workplace are in part determined by the characteristics of the physical work environment (Macik-Frey, Quick, & Nelson, 2007). Physical work environment conditions have been associated with stress and have also been identified as a strong predictor of pain and physical illness (Cooper & Cartwright, 1997; Shannon et al., 1997). The physical approach to safety has mainly focused on altering the ergonomic design of the workplace, improving work-related equipment and eliminating objective risks and hazards from the physical workplace environment. The results reported in paper III of this thesis indicated that employees' perceptions of the workplace safety climate explained more of the variance in the perception of the physical work environment, while a smaller amount of variance was accounted for in the perceptions of the psychosocial work environment. One reason for this difference can perhaps be found in the meaning of the terms physical and psychosocial work environment. The physical work environment, as measured in paper II and III in this thesis, consists of elements such as working in an environment characterised by noise, exposure to chemicals, vibrations, and weather exposure. Based on the measurement of the physical environment used in the present thesis, it can be argued that attributes of the physical work environment are more directly observable for the employees, and hence also attributed as a larger concern for safety issues in the workplace. As previously stated, offshore oil and gas employees have to deal with a range of hazards in their work activities on a daily basis. Of these hazards it can be argued that, since the physical environment is more observable to them, it is also hazards in the physical work environment that will generate the largest amount of perceived risk and feelings of reduced safety for these workers. Furthermore, the stressors that are part of the objective physical work environment are thought to be more controlled and manageable as opposed to stressors identified in the psychosocial work environment, which are harder to measure and control due to the fact that they carry unique connotations for each individual worker within the work environment (Baker et al., 2003). In the research literature, it has been argued that hazards, mostly identified as physical workplace conditions, are less subject to interpretations than other more socially oriented values (Prussia et al., 2003). It has also been argued that the work safety climate may provide a context in which individuals assess the physical hazards (Mearns et al., 1996), thereby underlining the close association

identified between the physical work environment and the work safety climate shown in the present work.

#### **4.4.1.4 Health, safety, environment and self-reported involvement in occupational accidents**

It has been stated that HSE at the organisational level will strive to eliminate occupational injuries and accidents in the workplace. Previous research has identified a strong link between the employees' perceptions of the safety climate and the frequency of occupational accidents (Gillen et al., 2002; Wallace, Popp, & Mondore, 2006). Generally, occupational accidents have been described as the end result of an unsatisfactory interaction with the work environment (Attwood et al., 2006b), and accident occurrence is considered to be a question of how well the individuals react to their environment to prevent, mitigate the results of, or recover from a potential accident (Attwood, Khan, & Veitch, 2006a). It is generally recognised that both individual and organisational factors contribute to an organisation's accident rates. The results reported in paper III in this thesis showed that the employees' perceptions of the work safety climate and the physical work environment exerted direct effects upon the employees' self-reported involvement in occupational accidents. More specifically, the results indicated that these variables contributed differently in the eight work groups used, explaining differing amounts of the variance in self-reported accident involvement. The results reported as part of this thesis therefore corroborated the important role played by management, employee competence, risk perception, and the organisation's safety system in the accident involvement process (i.e. the dimensions used to measure the work safety climate in paper III).

It is important to note, however, that occupational accidents are rare events (Seo, Torabi, Blair, & Ellis, 2004), and, as shown in paper III, only 368 respondents reported that they had experienced one or several such events during the last year. It can also be argued that the accident measure as used in the TRL questionnaire constitutes a sub-optimal measure of occupational accidents, and supplying the self-reported accident data used with archival data on accidents, injuries, and self-reported violations in conjunction with self-reported measures on accidents would have enhanced the reliability of the accident variable. Furthermore, research indicates that accidents and self-reported violations may be subject to recall bias, and that the actual recall of accidents only extends up to four weeks. Social biases could therefore undermine the reliability of the reported results.

#### **4.4.1.5 Estimating the health, safety and work variables with Structural equation modelling**

The relationships between the health, safety, and work environment variables were examined by applying structural equation modelling (SEM) in papers II and III of this thesis. Also, paper IV employed a SEM model to investigate the effect of a large-scale safety programme on behaviour and safety culture change in a sample of employees in a Norwegian-based operator company. SEM modelling represents an advancement in social science research by subsuming and extending correlation, regression, factor analysis, and path analysis (Schumacker & Lomax, 1996). The advantages of applying SEM methodology are that it allows the researcher to include more “flexible” assumptions and the use of confirmatory factor analyses to reduce measurement error by having multiple indicators per latent variable. Also, the SEM methodology allows for a test of the overall model at the same time, allowing for simultaneous analysis of a series of structural equations, whereas e.g. multiple regression analysis allows the analysis between a single dependent variable and several dependent variables within a single regression equation. Furthermore, the use of SEM estimation provides the researcher with a range of different fit indices to assess the overall fit of the structural model. Consensus over several fit indices can be used to assess the relative fit of the overall model, which was performed in papers II to IV in the present thesis.

It is also important to note that SEM modelling does not allow for inferences regarding causality. In the present context it can be argued that the relationship could have been reversed, i.e. that employee (ill) health influences the employees’ perceptions of the work environment and the work safety climate. A further important point is that all the models applied to the data only represent approximations of the reality (MacCallum & Austin, 2000; MacCallum, 2003). It is, for instance, difficult to include all the variables/factors that are believed to influence employee health in one structural equation model. This illustrates a central limitation associated with SEM modelling, i.e. the problem of omitted variables. Such omissions might lead to a misleading picture of the outcome measures, and additionally lead to biased parameter estimates and inaccurate estimates of the standard errors (Kaplan, 1989; Reichardt, 2002). An additional problem associated with omitted variables is that structural models routinely include residual terms that denote the composite effects of the unmeasured influences on a given variable. The variances of such residual terms are usually freely estimated parameters in structural models. The problem is that the importance of residual variance and covariance in terms of generating model fit are often underestimated.

Taken together, the limitations associated with SEM modelling underline that a good model fit does not necessarily guarantee that all the relevant variables are included in the model, and further highlight the fact that structural equation models are confirmatory in nature and need to have established a theory about the relationships prior to estimation. In the present context, SEM models were applied to test relationships that have previously been well founded in theory and in empirical research.

#### **4.4.2 Employee health**

The results reported in this thesis showed that the workers who participated in the different studies formed healthy work groups that reported few obvious symptoms of ill health. The employees also rated their general health status as good or very good. The findings in the present work are therefore in line with previous empirical research in the oil and gas industry, stating that poor health and obvious illness among these workers is relatively rare. These results have in previous research been attributed to the fact that employees working in the oil and gas industry undergo a medical examination every second year to ensure that they are mentally and physically prepared to meet the demands associated with offshore work. For instance, the medical guidelines for offshore work state that all persons working offshore should be medically fit to perform their work tasks in a safe and correct manner.

Employee health in the present context is based on the use of self-reported data (e.g. subjective health complaints, and general health status). The use of self-reported data is subject to the existence of various response sets, e.g. a psychological orientation or a kind of readiness to answer questions in a particular way (Norris, Matthews, & Riad, 2000). These response sets may create distortions in the information being assessed (Carver & Scheier, 2000). One such response set is social desirability, referring to the fact that people have the tendency to represent themselves in a good or favourable light (i.e. socially desirable ways) whenever possible. Socially desirable responses can cause scores to be skewed, i.e. a true “picture” of the population at hand will not be obtained. The response set of social desirability can represent a problem concerning responses, for instance, to the reports of subjective health complaints as well as self-reported involvement in occupational accidents and incidents because the respondents may seek to depict themselves in the most socially acceptable ways. However, despite the fact that the presence of response sets can not be excluded from the studies conducted as part of this thesis, the possible problems these represent are assumed to be minor, particularly because the samples in question (specifically the samples used in

papers II and III) are large and representative samples of the population at hand. Furthermore, the respondents completed the questionnaires voluntarily and anonymously (i.e. single respondents from specific organisations could not be identified). Accordingly, it was assumed that the presence of different response sets and their negative influence on the reported results would be minor in magnitude, i.e. the employees do not have any obvious reason to respond other than truthfully to the questions being asked.

#### **4.4.2.1 The notion of health**

At the present moment, relatively little is known about health and well-being related to work and safety among employees in the oil and gas industry. Few studies have examined the influence of work-related variables on resulting (ill) health among this group of workers in Norway. However, a few of studies, more specifically from the UK and China, have examined the relationship between work-related variables (i.e. both psychosocial and physical) and resulting ill health outcomes among onshore and offshore oil and gas workers, such as increased frequency of musculoskeletal complaints and increased perception of psychological distress (Chen et al., 2005; Cooper et al., 1987; Parkes et al., 2005; Parkes, 1999; Parkes, 2002; Sutherland & Cooper, 1991). Three of the four papers included in this thesis sought to examine the health concept in more detail in the Norwegian oil and gas industry relative to the employees' perceptions of work- and organisation- (i.e. the work safety climate) related variables. Different measures of self-reported health were used: paper I used the Subjective Health Complaints Inventory (SHC) and paper II used twelve symptoms as defined through the TRL project and one single item measuring the perception of general health status. Paper II also investigated the respondents' self-reported impairments in daily work activities offshore vis-à-vis the reported ill-health symptoms (PSA, 2001; PSA, 2003). Paper III also used the ill health symptoms developed by the PSA through the TRL project and included a measure of the employees self-reported general health status.

#### **4.4.2.2 A healthy workforce – results**

Paper II used data collected from offshore workers at two points in time (i.e. in 2001 and 2003). The results reported showed that the employees rated their general health status as good or very good. Nevertheless, regarding the used symptoms of ill health, 55 per cent of the 2001 workers and 57 per cent of the 2003 workers reported that they had experienced at least one symptom of ill health during the past three months (e.g. musculoskeletal pains, impaired hearing, and allergic reactions). This means that there appears to be a gap between the perception of general health status, which is thought to be a summary statement of how

employees perceive various health conditions (e.g. the social, physical, and mental) and more specific symptoms of ill health. Also, these results indicate that the employees in 2001 and 2003 experienced several symptoms of ill health, without this necessarily being related to disease or a reduced perception of general health status. One reason for these results might be found in the content of subjective health complaints. Tveito (2006) has described subjective health complaints (i.e. symptoms of ill health) as the “everyday complaints we are all bothered by, but in most instances not so much bothered that we need health care or are absent from work” (Tveito, 2006). Also, research has demonstrated that the employee perception of subjective health complaints is quite common in the general working population (Svensen et al., 2007). A poor or fair self-rated general health status on the other hand has in previous research been associated with the most acute and chronic diseases. This means that, in order to be able to talk about illnesses in the working population, i.e. offshore oil employees, their perception of their general health status appears to be the most valid measure, and the most indicative measure concerning the health concept in the more composite concept of HSE.

#### **4.4.3 The health concept in the composite HSE construct**

The health of workers employed onboard offshore oil and gas installations is an important issue for the different enterprises operating on the Norwegian continental shelf (NCS). It has been argued that employee health and well-being in the working context constitute the “end point” for successful work with health, safety, and the work environment. It can also be argued that the objective of the composite concept of HSE culture/climate is to prevent a decline in individuals’ health caused by the working conditions, to protect workers in their employment from risks resulting from occupational health hazards, and to place and maintain workers in an occupational environment adapted to their physiological and psychological abilities (Savinainen et al., 2004; Schonstein & Verbeek, 2006). This argumentation stems from a realisation that the workers in an organisation are an investment that needs to be effectively managed so that it can yield a high return of sustainable competitive advantage for the organisation (Keyes & Grzywacz, 2005; Luthans & Youssef, 2004; Zacharatos et al., 2005).

Based on the above, this can be related to the organisational support theory and to the effort reward imbalance model and the social exchange theory (Eisenberger, Huntington, Hutchinson, & Sowa, 1986; Siegrist, 1996; Whitener, 2001). Through these theoretical accounts, it is suggested that employees form a general perception concerning the degree to

which the organisation values their contribution and cares about their well-being. Additionally, the ERI model focuses on the concept of social reciprocity and argues that work tasks are performed for equitable rewards (Bambra et al., 2009; Shannon et al., 2001). These general perceptions in turn help the employees to determine the enterprise's willingness to reward increased effort, to help them complete their job tasks and to aid the employees in coping with stressful situations in the context of work. The assumption is that a positive general perception of the organisation's concern for their well-being will produce changes in the individuals that "oblige" them to respond positively to treatment from others, i.e. through the norm of reciprocity (Eisenberger et al., 1986; McLeroy, Steckler, & Glanz, 1988). Favourable treatment from the organisation will result in increased commitment to the organisation and greater trust in the management, which in turn will lead to improved performance and also to improved subjective health perceptions and increased well-being among the workers (Wilson et al., 2004). It is also assumed that employees' global perceptions of the enterprise as well as their perceptions of more specific facets of organisational functioning will influence behaviour, for instance towards occupational risks and involvement in occupational accidents. Hence, the implication is that organisations fostering a health-strengthening environment will also promote and facilitate healthy behavioural norms, ultimately contributing to better health and safety among the workforce.

Based on the mentioned argumentation, it is assumed that, in order to improve or maintain worker health and well-being, an organisation (e.g. an offshore oil installation) should aim to improve its health culture/climate. The reasoning being that an improved health climate will foster positive behaviours and attitudes from the workers through the norm of reciprocity. Previous research has suggested that characteristics of a positive health climate include perceptions of organisational support, interpersonal support, and health norms. These dimensions have in turn been associated with decreases in physical symptoms of ill health, and an increase in health promotion behaviours such as increased exercise and an increased focus on nutrition (Ribisl & Reischl, 1993). This association has also been corroborated in the offshore work environment (Mearns, Hope, & Reader, 2006). Mearns and colleagues' (2006) research assessed the health climate on 18 offshore installations on the UK continental shelf. Their results showed significant correlations between various health climate dimensions and different safety behaviours, organisational citizenship behaviours, and organisational commitment. Future research in the Norwegian oil and gas industry should perhaps focus



more attention on the dimensions of “health climate” and use these as early warning signs to measure the health status in the workforce employed onboard offshore oil installations.

#### **4.4.3.1 How to measure health in the composite concept of HSE**

On the basis of the results in the present work, it can also be argued that using symptoms (predominantly physical) of ill health as an indication of a person’s perceived health status, among a sample of initially healthy employees, represents too narrow an account of individual health. In order to obtain a sound indication of the HSE culture/climate, the more holistic, positive definition of health perhaps should be used to a greater extent. As mentioned previously, a person’s health status has many determinants, and symptoms caused by the work situation represent only one facet of this overall perception, particularly so if the employees in question do not perceive that they are severely affected by the included complaints. Compared with the use of symptoms of ill health, it is here assumed that self-ratings of current general health status provide a simple, direct, and global way of capturing perceptions of health. As previously mentioned, this idea is conceptualised as broadly and inclusively as the respondents choose to make it, i.e. it allows them to take several measures of health into account (Idler & Benyamini, 1997). The validity of such measures is supported in studies that show a strong relationship between self-rated general health and mortality (Frankenberg & Jones, 2004). However, it is also important to note that using the perception of general health status as an individual-level variable may convey different meanings depending on the person’s individual interpretation of the term health, thereby making it less appropriate to use when the objective of the study concerns occupational illnesses and diseases.

It is also argued that, in order to obtain a more overarching insight into employee health, a different terminology perhaps should be applied, i.e. a focus on positive aspects of employee health. “Positive” health, as defined by the World Health Organisation, is not merely the absence of disease or infirmity; it represents a complete state of mental, social, emotional, spiritual, and physical well-being (WHO, 1948). Also, a holistic perspective of health has been called for, one that would include both mind–body interactions and wellness (Macik-Frey et al., 2007). For example Ryff and Singer incorporated six components into their description of personal well-being. These were: autonomy, personal growth, mastery of the environment, positive relationships with others, purpose in life, and self-acceptance (Ryff & Singer, 1998).

According to the theoretical accounts that provided the basis for this thesis, it is suggested that an individual's work role also has potential for "positive health", or no damaging effects of work-related exposures on employee health. The demand-control model (Karasek et al., 1990) postulates that high strain jobs (i.e. high psychological job demands and low decision latitude) are related to symptoms such as depression, job dissatisfaction, and an increase in sickness absence. The model also suggests that the "best" job is one in which the perceived job demands and perceived decision latitude are balanced, termed an "active job". Workers inhabiting what Karasek and Theorell (1990) name the active job find that challenges inherent in their jobs are matched by equivalent levels of control and thus these workers do not experience any ill-health effects associated with work. The active job has instead been described in terms of learning, motivation, productivity, and participation, benefiting both the individual and the organisation. Studies have demonstrated that high levels of perceived control over work tasks are related to a high rate of positive health- and work-related outcomes (Mullarkey et al., 1997). The implication for the creation of a positive climate for employee health outcomes is that job redesign efforts should direct their foci towards the enhancement of employee work control. This can, for instance, be achieved through participative decision-making efforts, as this strategy increases the workers' perception of control and in turn has favourable effects on employee health and safety. Likewise, paper IV included in this thesis demonstrated the significance of developing worker commitment and the importance of comprehensive implementation of programme activities to increase the likelihood of behavioural and cultural changes concerning safety.

The discussion in the sections above necessitates a question concerning how much variance work- and organisation-related variables can account for in health, including a sample that is initially healthy. Semmer (2003), for instance, has argued that, given the complex aetiology of physical morbidity and psychological symptoms, it would be strange if measures of work-related variables could account for more than 10 per cent of the variance in self-reported health (Semmer, 2003; Shannon et al., 2001). This line of reasoning is in accordance with the results in the thesis.

Based on the low amount of explained variance in the outcome measures, it can be argued that the results point in the direction of a need to examine new measures in order to understand better the relationship between work, safety, and health in the oil and gas industry. Previous research has indicated that stressors at work are a possible source of impaired health, well-

being, and performance, and furthermore indicated that decreased *well-being* is an early warning sign in terms of developing ill health as a consequence of work. Well-being has been defined as the positive outcomes of a number of psychological, social, and emotional factors, that represents the subjective feelings about one's life and the context of which it is being lived (Mezzich, 2005; Tucker, Sinclair, & Thomas, 2005). Employees' perception of decreases in well-being may be a preliminary stage of more severe psychological and physiological health complaints, and therefore this concept should be studied relative to perceptions of work- and organisation-related variables in the oil and gas industry.

#### **4.4.3.2 Summary**

In summing up, a shift of focus to a broader definition of health is suggested, when the objective is to study the association between work- and organisation-related variables and employee health perceptions. The results reported in this thesis also warrant a closer examination of the relationship between employees' perception of their general health status and their self reported symptoms of ill-health. Furthermore, it has been suggested that the relationship between employee health and the concept of organisational health should be investigated to a greater extent. This is because the concept of organisational health combines organisational performance with employee health and quality of work life. Ultimately, the idea is that the structure and fabric of the organisation can have a wide-ranging impact on the health and well-being of the employees and also on the organisation itself (Wilson et al., 2004).

### **4.5 The cultural adaption**

As previously stated, the composite concept of health, safety, and environment (HSE) deals with the complex interaction between technology, organisations and people. The results of the present work have been more directed towards the organisations (e.g. offshore oil installations) and the people. The culture/climate concept has been incorporated to explain the development of and changes in the HSE status in the oil and gas industry, and has also been adopted by the individual enterprises operating within the sector. However, no agreed upon definition of, or operationalisations of the culture and climate concepts have been obtained in the research literature (Baek, Bae, Ham, & Singh, 2008; Clarke, 2006; Parker et al., 2003), which has increased the complexity incorporating culture/climate into the composite notion of HSE.

In the research literature it has been argued that researchers have adopted their views concerning organisational and safety *culture* through either the functionalist or interpretive

perspective (Glendon et al., 2000). The interpretive perspective argues that the culture serves as the prime medium for members to interpret their collective identity. It is seen as a bottom-up process, allowing for the existence of sub-cultures/sub-climates within an organisation (Glendon et al., 2000). The functionalist perspective on culture, on the other hand, has been described as a top-down process, because the culture is seen as a critical “value” influencing specific outcomes (Clarke, 2006; Waring, 1996). The views adopted in the present thesis are more in line with the interpretive approach to culture. It is assumed that an organisation’s culture exists on several levels, i.e. within different work groups or departments on an operative offshore oil installation. Furthermore, it is assumed that characteristics of the external environment (e.g. national culture, economic situation) are elements that, while existing outside the boundaries of the organisation, have the potential to affect all or part of it, thereby influencing the specific culture/climate found in an organisational unit. It is, however, important to note that the results in the present thesis mainly assesses *climate*, since the data used primarily represent individual perceptions of organisational events and practices related to HSE. Also, the results presented are drawn from cross-sectional data collections. According to researchers within the organisational culture/climate field, the use of questionnaire studies often fails to expose the “core” of an organisational culture and represents a “snapshot” of employee perceptions of organisational practices collected at one specific point in time (Guldenmund, 2000; Guldenmund, 2007; Hale, 2000). Although the results of this thesis are mainly assessing the work safety *climate*, the culture notion is also used in the discussion and explanations. This is in accordance with previous empirical findings indicating that an organisation’ climate (e.g. concerning safety) is a manifestation of the organisation’s culture (Richter et al., 2004). This implies that an organisation’s current state of HSE climate is a surface-level manifestation of its more stable HSE culture.

#### **4.5.1.1 Work with health, safety and the work environment in the Norwegian oil and gas industry**

Work with HSE within the Norwegian oil and gas industry in the time period from the 1990s up until the present, has been described in terms of the search for a “cultural adaption”. It has become of primary importance to understand how knowledge, values, norms, ideas, attitudes, and framework conditions act together and influence the HSE level within the industry. All of the previously mentioned aspects influence how an organisation, a work group, and an individual think and act according to issues relevant for HSE. It might therefore be argued that the utility of the culture concept particularly has underlined the need for organisations to study HSE from a broader perspective (e.g. by using a broader methodology and within an

interdisciplinary research field). A problem, however, might be that “everything” can be easily subsumed under the heading of culture, whether it is symptoms of ill health, well-being, employee behaviour, employee or leadership attitudes, or safety issues making it difficult to decipher what the driving forces and themes actually are. The overall aim of using HSE culture/climate conceptualisation within the workplace is that it is seen as a means to reduce accidents and injuries offshore at the same time as the organisation continues to work effectively and productively (Gillen et al., 2002). In other words, the culture/climate concept can be viewed as a means to balance the priorities between different aims existing within each individual organisation. The culture/climate of an organisation describes the ways in which its participants make sense of their working environment and their surroundings (Denison, 1996; Piirainen et al., 2003), and is therefore regarded as important to understand *what* happens within an organisation and *why*. In the research literature there is increasing evidence showing that certain aspects of the organisational culture/climate play key roles in organisational outcomes, such as accident frequency, innovation willingness, productivity, and absenteeism (Basen-Enquist et al., 1998). Also, it was shown in paper IV of this thesis that employees reports of organisational safety culture change influenced employee reports of safety behaviour and vice versa.

Whereas the most common topic in the research literature currently is the concept of safety culture/climate, the Norwegian government as well as the petroleum industry have chosen to direct their focus towards the health, safety and environment culture/climate. The petroleum regulation states that each organisation that operates on the Norwegian shelf is responsible for developing a sound culture for HSE. The view adopted by the PSA is that culture is a phenomenon that is not conscious, implying that it is difficult to verbalise. The argument is that if one studies culture one must direct the focus towards the more implicit elements that are the origin of behaviour, and, furthermore, that typical employee behaviour patterns and attitudes within organisations allow for conclusions to be drawn about the content of culture. The mentioned view adopted by the PSA approach should imply that deciphering what culture is should be performed at the most localised level possible, i.e. the individual in the work group and the work group itself. This was achieved in papers I and III included in this thesis. The work safety climate and its effect upon the physical and psychosocial work environment, and also on employee health and self-reported involvement in occupational accidents, were analysed in different work groups employed onboard different offshore oil installations (paper III). The results showed clear and significant differences between the groups, and it is thought

that these differences can be explained by the specific work environment and the individuals in specific work teams as argued previously.

#### **4.5.1.2 A climate for health and workplace climate**

Lee and Harrison (2000) conceptualised safety culture as the organisations proactive stance towards safety (Lee et al., 2000). The related concept of a safety climate has been seen as the employees' perceptions of the state of safety within the organisation and has been studied as a causal factor for safety performance and satisfaction with the safety status (Guldenmund, 2000). The present thesis suggests that there exists a climate for health as well as a workplace climate. Furthermore, the results reported as part of this thesis indicate that employee health perceptions and perceptions of the work environment are more closely related than with the work safety climate. It is assumed that these climates are highly related, but they ought to be studied as separate entities as indicative of the organisations overall climate for health, safety, and the working environment. It is also assumed in the present work that these climates exist at different levels in the organisation. While the climate for health can be said to exist mainly at the individual level, the safety climate and the climate for the working environment exist at the work group level. The employees' perceptions of subjective health and well-being constitute both the starting point and the end point in the overall notion of HSE, and the perception of the work environment and the work safety climate are filtered through the employees' evaluations of their health and well-being.

### **4.6 National culture and the work–health relationship**

Hofstede (1990) incorporates “social values” into his conceptualisations of the organisational culture concept. These are norms, beliefs, and values that result from upbringing and that remain relatively stable throughout a person's life. According to Hofstede (1990), the national culture plays an important role in shaping organisational culture (Hofstede, 1990). The safety culture/climate concept was in the present work regarded as a more specific facet of the organisational culture, and hence also a more specified representation of the national culture.

National culture in the present thesis is conceptualised as the societal context in which an organisation must exist. The impact of national culture on organisational culture is reflected in a number of ways, ranging from the constraints imposed on organisations by its national authorities and the operational environment to the mentality and habits of the members of the organisation. The view adopted in the present thesis was presented in Figure 1.1 on page 3. It recognises that the overall national culture will influence the goals, vision statements, and

guidelines adopted by the petroleum sector, which in turn will influence how the organisations operating within this sector view issues related to HSE.

The empirical work reviewed as part of this thesis draws heavily on research conducted on the UK continental shelf. In 2004 it was stated by the Norwegian research council that the British HSE authorities in the period from the beginning of the 1990s up until 2004 had invested significantly in increasing the skills and resources among regulators. However, during the same period in Norway, research concerning HSE in the industry had declined. Hence, more literature exists concerning workers on the UK continental shelf than workers on the Norwegian continental shelf, particularly with regard to explorations of the relationships between work-, organisation-, and health-related variables. It is important to note, however, that conditions within the UK oil and gas industry are not necessarily comparable with conditions in the Norwegian oil and gas industry. The labour costs on the Norwegian part of the shelf are for instance higher than the labour costs on other international shelves. However, it is also highlighted in the literature from the UK oil and gas industry that jobs offshore are relatively well paid compared with other onshore-based industries. The International Labour Organization attributed this to the “special working conditions offshore” (International Labour Organization, 2002). Also, differences between the shelves can be identified in terms of working hours per week and also in the use of different shift patterns in the offshore work operations. For instance, the working hours on the Norwegian continental shelf are the same as for continuous shift work conducted onshore. All the agreements used for fixed and mobile installations in Norway are based on 33.6 hours of work a week. The offshore working time in Norway is 12 hours per shift, and the most common shift rotation is 2 weeks offshore followed by a 4 week rest period onshore. In comparison, UK offshore oil workers have a 48 hour maximum working week, and the use of overtime is frequent. Also, on installations on the UKCS, the most common work pattern is 2 weeks offshore alternating with 2 weeks of onshore leave (Parkes, 2007).

In terms of the impact of national culture on worker and organisational occupational health and safety, the cultural convergence theory has argued that the processes of industrialisation and globalisation have led to more uniform industrial attitudes and behaviours, which have resulted in similar organisational structures and hence more common business strategies and values. Tan (2002) examined this cultural convergence hypothesis in a sample consisting of Chinese managers across different countries, aiming to study their personal values. His

findings supported the cultural convergence theory, indicating that the processes of industrialisation and modernisation have made the personal value system of managers more similar across countries (Tan, 2002). In a similar vein, Mearns and Yule (2009) examined occupational safety and how the process of globalisation could influence the attitudes, behaviours, and beliefs of workers from different national cultures employed in the same multinational company. They reviewed literature on cultural differences in attitudes, perceptions, and beliefs regarding safety. Their results showed that more adjacent influences such as the employees' perception of management commitment and the efficacy of safety measures exerted a greater impact on employee behaviour and subsequent accident rates than measures of national culture (Mearns & Yule, 2009). Furthermore, in a comparative study among employees on the UK continental shelf and the Norwegian continental shelf, Tharaldsen and colleagues (2008) observed that there were similarities between these groups of workers in terms of perceived trust, i.e. trust in colleagues, first line supervisor, and the offshore management (Tharaldsen, Mearns, & Knudsen, 2008). Also, their study showed that the type of work (i.e. occupational position) and installation type exerted a greater effect on safety climate, organisational culture, self-reported risk-taking behaviour, trust in co-workers and management's commitment to safety than the nationality of the workers did.

Taken together, the influence of national culture on employee attitudes, beliefs, and values has been increasingly recognised within the occupational health and safety field (Helmreich et al., 1998). Hence, the national culture might have influenced the results presented as a part of this thesis. However, research has indicated that industrialisation, modernisation and globalisation have contributed to making personal value systems among the workers increasingly similar, and showed that more adjacent influences seems to be of greater relevance in terms of perceptions of health, safety, and work environment.



## 5 Conclusion and further research

According to the Norwegian work environment act, workers have the right to be both protected and fostered in the context of work. This means that not only should workers be protected from physical and chemical hazards, but also that work should contribute to the promotion of health and well-being. The Norwegian oil and gas industry has tried to meet these requirements by studying health, (work) environment and safety within the notion of HSE culture/climate. It has been assumed that by exposing and awakening the “taken-for-granted” basic underlying assumptions concerning the HSE in an organisation it is possible to improve the HSE standards, and thereby also to reduce the frequency of ill health, injuries, occupational accidents, and near-misses in the workplace. The following conclusions can be drawn on the basis of the results in the thesis.

### 5.1.1.1 The relationship between health, safety and work environment

Employee health, safety, and work environment represent related, albeit not identical constructs. The relationship appeared to be stronger between the concept of employee health and their perception of the work environment than the relationship between employee health perceptions and the work safety climate (paper III). This implies that although the health, safety, and work environment concepts are implicitly linked, they do not represent one particular aspect of organisational functioning according to the results of the present thesis.

The present thesis therefore suggests that more specific examinations of the separate concepts are required. This is particularly the case in terms of employee health. The concept of health needs to be further elaborated and to take into account that it is a multidimensional concept and needs to be treated as such in future investigations regarding the composite concept notion of HSE and also with regard to HSE-culture/climate. The results of the present thesis suggest that a focus on one dimension (i.e. primarily specific health complaints) is limited, especially among a group of initially healthy employees. Furthermore, the results in the present thesis suggest that an exaggerated focus on one dimension of health makes the health concept less useful in the composite HSE culture/climate concept. By including a more elaborate measure of health (e.g. well-being and perception of general health status) this may have an added value by increasing the probability of detecting ill health effects caused by the work environment and the work safety status at an early stage.

Research concerning work-related variables and occupational health has primarily been concerned with the negative effects of demands and conditions in working life, such as stress, burnout, ill-health symptoms, turnover, and sickness absence. This research tradition has contributed to the prevention of negative incidents within the workplace, but has to some extent not been able to cover adequately the more positive aspect of work. There is a need to highlight the positive factors associated with work, i.e. factors that lead to well-being, positive health, and engagement. To achieve the goal of a healthy and safe workplace it is not enough to eliminate or reduce risk factors, but something positive also needs to be added. It does not seem realistic only to reduce demands associated with work, and job insecurity seems to be an essential feature associated with work; however, on the other hand, it seems realistic and viable to study positive factors associated with work, and the work environment as a means to decrease the sickness absence rates and furthermore to motivate individuals on sick leave to return to work.

#### **5.1.1.2 Differences in job, health and safety-climate/culture perceptions**

Various groups of employees face different organisational realities in their work. The results in the current thesis suggest that work, health, and safety perceptions should be studied at the sub-unit level of an organisation (e.g. an offshore oil and gas installation, an enterprise). Differences were identified both in terms of the objective work environment (i.e. onshore and offshore) and in terms of specific occupational positions in the organisation. Differences were also identified between employees based on age. The results of the present thesis therefore suggest that different sub-cultures or sub-climates exist within an organisation. The implication of these results is that interventions aimed at improving the overall HSE culture/climate may be more effective if they simultaneously address the individual level, the group level, and the organisational level of the workplace.

The current thesis is based on individual-level data, primarily collected through the use of cross-sectional surveys. This “individualistic” focus implies that the attention has been directed towards individual perceptions of aspects related to work and health, which may in turn have limited the ability to generalise the presented results, i.e. it is difficult to draw firm conclusions about other populations than the one in focus. Nevertheless, the results presented strongly imply that research within the field of HSE culture/climate needs to be *specific*, i.e. directed towards and also conducted at the lowest possible level of organisational functioning. In the questionnaire utilised this level was defined as the varying work groups or departments within the overall organisation. The employees’ experiences vary according to group

belonging, and this needs to be taken into account when referring to the overall notion of HSE, i.e. employees will evaluate HSE interventions within their work groups, and thereafter evaluate the relevancy of different interventions through the challenges they face in the course of their working day.

A specific focus, directed towards a “sub-group” of employees, is also considered important because of the trends observed within the industry and also within Norwegian working life today. It is a trend that enterprises seek to focus on their core competencies and sets out certain tasks or functions for suppliers. These suppliers will in turn outsource parts of the tasks to subcontractors. This implies a radical change in the regulatory framework to safeguard employee health, work environment, and safety, as well as the opportunities one has to prevent sickness absence and exclusion from working life. As stated in the introductory section of this thesis, the great majority of workers in the Norwegian oil and gas industry consist of contractor employees. It has been estimated that 70 per cent of the employees working on the Norwegian continental shelf are hired through contractor companies while approximately 30 per cent of the staff onboard an installation consists of employees hired through an operator company. This means that a large part of the employees working on the shelf work within occupational groups that are not employed by the companies that actually operate the platform. Future research should direct its focus towards the effective implementation for HSE, taking the sub-group structure of an offshore oil installation into account. A more thorough investigation of the framework conditions that are applicable to the various sub-contractors will make it possible to develop more effective HSE interventions, and also to develop interventions targeted towards the prevention of work-related ill health and exclusion from working life. Further research should be directed towards examining problems and challenges within the individual work groups as a measure to improve the HSE status in the workplace.

#### **5.1.1.3 HSE culture/climate**

Future research should try to decipher what a satisfactory culture/climate for HSE would entail (i.e. in terms of practices and procedures), and whether these practices and procedures are adequately interpreted and transformed into the workers’ behaviour. It is furthermore important to study the consequences of the “balancing of the organisation’s needs” and what the consequences are of a “good” or “bad” culture/climate for HSE. Theories within the occupational health field, for example, postulate that a range of damaging consequences for employee health can occur if the individual is exposed to a situation of long-term negative

stress within the workplace (Karasek et al., 1990; Siegrist, 1996). The experience of prolonged periods of stress can also inhibit the employee's ability to search for signs/cues signalling danger in the work environment, which in turn may be related to an increased accident/injury frequency. In a situation where psychological stress is experienced by an employee over a prolonged period of time it is more beneficial, from an individual's standpoint to focus the attention towards reducing or diminishing the uncomfortable consequences associated with the stressful experience, thus contributing to a "failure" to detect other relevant sources of information in the environment, and hence making the person more susceptible towards experiencing occupational accidents, injuries and near misses at work. This argument again underlines the importance of the work environment and stressors therein, and the need for these aspects to be treated properly within the HSE framework.

## **6 Final conclusion**

The industry has been in a process of continuous change during the past years, and it is reasonable to assume that it will continue to change. In the years to come, more fields will be less commercially profitable, indicating that we will see more waste disposal of installations, which again poses new challenges within the HSE area. Furthermore, the industry will become increasingly global, indicating a need to broaden the cooperation regarding health, environment, and safety across national borders. Furthermore, this increased globalisation will lead to more non-Norwegian workers onboard the installations, posing new challenges with regard to language barriers and communication about matters related to HSE. All in all, it might be possible to assert that, in light of these new challenges and several others, the industry as well as the research community must prepare for the future, and the best way to start, according to the results reported in the current thesis is towards a more elaborate as well as specific conceptualisation with regard to what the overarching notion of HSE really should imply.

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## PAPER II

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## APPENDIX I

### QUESTIONNAIRE USED IN PAPER I

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# HELSE I ABB OFFSHORE SYSTEMS M & MO

2004

LES DETTE FØR DU BESVARER SKJEMAET

## Bakgrunn og formål

I løpet av de siste årene har det blitt gjennomført en rekke tiltak for å forbedre sikkerhetsnivået i norsk oljevirksomhet. Man har i mindre grad rettet fokus mot de ansattes opplevelse av sin arbeidsplass og å ivareta de ansattes helse og arbeidsmiljø. Denne studien ønsker å undersøke hvordan de ansatte opplever arbeidshverdagen og sin egen helse, og spørreskjemaet inneholder primært spørsmål om dette.

## Hvem står bak?

Forskningsrådet finansierer denne undersøkelsen, og den gjennomføres ved Universitetet i Oslo av Anne Mette Bjerkan i samarbeid med Professor Britt-Marie Drotz-Sjöberg ([bjerkan@svt.ntnu.no](mailto:bjerkan@svt.ntnu.no)). Spørreskjemaet inngår som en del av et større prosjekt om "HMS-kultur" i Petroleumsindustrien. Dette er et prosjekt som drives av Senter for teknologi, innovasjon og kultur (TIK - senteret) ved Universitetet i Oslo, med ansvarlig prosjektleider forsker Knut Haukelid.

## Frivillighet og konfidensialitet

Deltagelsen i undersøkelsen er frivillig. Dersom det finnes spørsmål i skjemaet som du mener du ikke kan eller vil besvare, gå videre til neste. Vi håper allikevel du vil svare på så mange spørsmål som mulig. Dette vil også sikre kvaliteten på undersøkelsen.

All informasjon behandles konfidensielt. Skriv derfor ikke navn på skjemaet. Når dataene analyseres og rapporteres, vil ingen se hvem som har avgitt hvilke svar. Bedriften vil heller ikke få tilgang til noen bakgrunnsopplyninger.

## Utfylling av skjemaet

Det er ingen riktige eller gale svar på spørsmålene - vi er ute etter din oppriktlige mening og oppfatning. Sett bare ett kryss på hvert spørsmål om ikke annet er oppgitt.

Har du spørsmål om spørreskjemaet eller undersøkelsen kan du kontakte:

Anne Mette Bjerkan  
Stipendiat  
Senter for teknologi, innovasjon og kultur  
Universitetet i Oslo  
Tlf: 22 84 06 30  
E – mail: [a.m.bjerkan@tik.uio.no](mailto:a.m.bjerkan@tik.uio.no)

På forhånd tusen takk for at du deltar!

### 1) Type arbeid

Kryss av for hvilke typer oppgaver du utfører i din arbeidsdag.

- |                               |  |
|-------------------------------|--|
| 1. Rør.....                   | 6. Mekanisk.....                       |
| 2. Stål.....                  | 7. Service.....                        |
| 3. Isolasjon.....             | 8. Overflatebehandling.....            |
| 4. Elektro og instrument..... | 9. Administrativ/ kontorpersonale..... |
| 5. Ingeniør.....              | Annet.....                             |

Har du lederansvar? Ja ☐ Nei ☐

### 3) Hvor stor andel av din arbeidstid har du i løpet av det siste året vært:

a) Offshore

- |                |                          |                |                          |
|----------------|--------------------------|----------------|--------------------------|
| 1. 100 – 75 %? | <input type="checkbox"/> | 1. 100 – 75 %? | <input type="checkbox"/> |
| 2. 74 – 50 %?  | <input type="checkbox"/> | 2. 74 – 50 %?  | <input type="checkbox"/> |
| 3. 49 – 25 %?  | <input type="checkbox"/> | 3. 49 – 25 %?  | <input type="checkbox"/> |
| 4. 24 – 0 %?   | <input type="checkbox"/> | 4. 24 – 0 %?   | <input type="checkbox"/> |

### 4) Hvor mange timer jobber du?

a) i gjennomsnitt hver uke  (antall timer)

b) Som mest hver uke  (antall timer)

### 5) Beskrivelse av jobben

Stemmer svært godt	Stemmer nok så godt	Både og	Stemmer nok så dårlig	Stemmer svært dårlig
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1. Arbeidet mitt innebærer arbeid med farlige kjemikalier.

2. Arbeidet mitt gjør at jeg utsettes for luftforurensning og høye konsentrasjoner av støv.

3. Arbeidet mitt utsetter meg for støy.

4. Arbeidsmetodene som benyttes er ofte forbundet med risiko.

5. Jeg arbeider med farlig verktøy og maskiner.

6. Det er ofte rot og uorden på min arbeidsplass.

7. Arbeidet mitt gjør at jeg er sårbar for skader.

8. Jeg utfører en rekke forskjellige oppgaver i min jobb.

9. Jobben min medfører at jeg ofte jobber i ubehagelige stillinger.

### 6) Jobbkraav

Besvar spørsmålene ut fra din nåværende arbeidssituasjon

Mest godten eller aldri	Nok så spelden	Av og til	Nok så ofte	Mest ofte eller alltid
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1. Er arbeidsbelastningen din ujevn slik at arbeidet hopper seg opp?

2. Må du arbeide overtid?

3. Er det nødvendig å arbeide i et høyt tempo?

4. Har du for mye å gjøre?



11) Mestring av arbeid

	Meget sjelden eller aldri	Nokså sjelden	Av og til	Nokså ofte	Meget ofte eller alltid
1. Er du fornøyd med kvaliteten på arbeidet du utfører?	1	2	3	4	5
2. Er du fornøyd med mengden av arbeid du får gjort?					

	Meget sjelden eller aldri	Nokså sjelden	Av og til	Nokså ofte	Meget ofte eller alltid
3. Er du fornøyd med din evne til å løse problemene som dukker opp i arbeidet?	1	2	3	4	5

4. Er du fornøyd med å ha et godt forhold til dine arbeidskolleger?					
5. Får du informasjon om kvaliteten på arbeidet du utfører?					
6. Kan du selv umiddelbart avgjøre om du har gjort et godt eller dårlig arbeid?					

12) Sosialt samspill

	Meget sjelden eller aldri	Nokså sjelden	Av og til	Nokså ofte	Meget ofte eller alltid
1. Om du trenger det kan du få støtte og hjelp i ditt arbeid fra dine arbeidskolleger?					
2. Om du trenger det, kan du få støtte og hjelp i ditt arbeid fra din nærmeste leder?					
3. Om du trenger det, er din nærmeste leder villig til å lytte til deg når du har problemer i arbeidet?					
4. Om du trenger det, kan du snakke med dine venner om problemer du har i arbeidet?					
5. Om du trenger det, kan du snakke med din partner eller en annen nær person om problemer du har i arbeidet?					
6. Blir dine arbeidsresultater verdsatt av din nærmeste leder?					
7. Har du lagt merke til forstyrrende konflikter mellom arbeidskolleger?					
8. Føler du at du kan stole på at venner og familie vil støtte deg om det blir vanskelig på jobben?					

13) Forhold til kollegaer og nærmeste leder

	I svært liten grad	I liten grad	Av og til	I noen grad	I svært stor grad
1. ...forholdet til dine kolleger påvirker ditt arbeid positivt?	1	2	3	4	5
2. ...forholdet til din nærmeste sjef påvirker arbeidet ditt positivt?					
3. ...du kjenner dine kolleger?					
4. ...du kjenner din nærmeste sjef?					
5. ...du kan snakke med dine kolleger om personlige problemer?					
6. ...du kan snakke med din nærmeste sjef om personlige problemer?					
7. ...du har tillit til dine kolleger?					
8. ...du har tillit til din nærmeste sjef?					
9. ...dine kolleger øker din sikkerhet på jobb?					
10. ...din nærmeste sjef øker din sikkerhet på jobb?					
11. ...lidspres har negative effekter på dine sosiale relasjoner på jobb?					
12. ...dine kolleger også er dine venner?					
13. ...din nærmeste sjef er en venn/venninne?					
14. ...forholdet mellom deg og dine kolleger er preget av respekt?					
15. ...forholdet mellom deg og din nærmeste sjef er preget av respekt?					
16. ...du og dine kolleger er sammen på fritiden?					

14) Ledelse

	Meget sjelden eller aldri	Nokså sjelden	Av og til	Nokså ofte	Meget ofte eller alltid
1. Oppmuntrer din nærmeste sjef deg til å delta i viktige avgjørelser?	1	2	3	4	5
2. Oppmuntrer din nærmeste sjef deg til å si fra når du har en annen mening?					
3. Hjelper din nærmeste sjef deg til å utvikle dine ferdigheter?					
4. Prøver din nærmeste sjef å løse problemer med en gang de dukker opp?					
5. Fordeler din nærmeste sjef arbeidsoppgaver rettferdig og upartisk?					
6. Behandler din nærmeste sjef de ansatte rettferdig og upartisk?					
7. Er forholdet mellom deg og din nærmeste sjef en kilde til stress for deg?					

15) Organisasjonsklima

Hvordan er klimaet i din arbeidsenhet?

	Svært lite eller ikke i det hele tatt	Nokså lite	Nokså mye	Nokså mye eller alltid
1. Konkurransorientert?	1	2	3	4
2. Oppmuntrende og støttende?				5
3. Mistrisk og mistenksom?				
4. Avslappet og behagelig?				
5. Stivbeint og regelstyrt?				
6. Stolte du på bedriftens evne til å ivareta bedriftens virksomhets fremtid?				

1. Tar de ansatte selv initiativ på ditt arbeidssted?									
2. Blir de ansatte oppmuntret til å tenke ut måter for å gjøre tingene bedre på ditt arbeidssted?									
3. Er det god nok kommunikasjon i din aveling?									
4. Har du lagt merke til om menn og kvinner blir behandlet ulikt på arbeidsstedet ditt?									
5. Har du lagt merke til om yngre og eldre arbeidstakere blir behandlet ulikt på arbeidsstedet ditt?									
6. Får du belønning for velgjort arbeid i din bedrifts virksomhet (penger, oppmuntning)?									
7. Blir de ansatte tatt godt vare på i din bedrifts virksomhet?									
8. Hvor mye er ledelsen i din bedrifts virksomhet opptatt av de ansattes helse og velvære?									

16) HMS arbeidet i bedriften

	Helt uenig	Uenig	Både og	Enig	Helt uenig
1. Bedriften tilrettelegger arbeidsforholdene slik at den enkeltes helse ikke skal bli skadelidende	1	2	3	4	5
2. Bedriften prioriterer helse					
3. Bedriften prioriterer arbeidsmiljø					
4. Bedriften bryr seg ikke om de ansattes helse så lenge jobben blir gjort					
5. Bedriften legger til rette for at de ansatte kan komme tilbake til arbeid etter at de har opplevd en ulykke eller vært langtidssykemeldt					
6. Bedriften kan i stor grad tilrettelegge for et godt arbeidsmiljø					
7. Helse og arbeidsmiljøproblematikk er sentrale diskusjonstemaer i bedriften					

	Helt uenig	Uenig	Både og	Enig	Helt uenig
8. Bedriften drøfter og lærer av uønskede hendelser	1	2	3	4	5
9. Bedriften viser i handling at de tar helse og arbeidsmiljøproblematikk på alvor					
10. Den enkelte ansatte er selv ansvarlig for at egen helse ikke skal bli skadelidende i arbeidet					
11. Jeg identifiserer meg med verdiene til bedriften jeg jobber i					
12. Økonomiske interesser går på bekostning av de ansattes helse					
13. Jeg vet hvordan jeg skal ta vare på min helse i arbeidssituasjonen					
14. Kommunikasjonen om helse og arbeidsmiljøproblematikk er god i bedriften					
15. Uønskede hendelser rapporteres alltid i bedriften					

17) Helse

Nedenfor nevnes noen helseplager. Vurder hvert enkelt symptom/problem og oppgi i hvilken grad du har vært plaget av dette i løpet av de siste 30 dager og antall dager du har vært plaget. Disse spørsmålene er vanlig å stille i helseundersøkelser, men alle trenger ikke å være like relevante for deg. Prøv likevel å besvare alle spørsmålene så godt du kan.

	Ikke plaget	Litt plaget	En del plaget	Alvorlig plaget	Antall dager plagene varte (ca)
1. Tretthet	1	2	3	4	5
2. Søvnproblemer					
3. Svimelhet					
4. Sveie i magen					
5. Sure oppstøt/halsbrann					
6. Smerter i øvre del av ryggen					
7. Smerter i skuldre					
8. Smerter i korsryggen					
9. Smerter i føtterne ved fysisk anstrengelse					
10. Smerter i armer					
11. Pustevansker					
12. Nedtrykthet/depresjon					
13. Nakkesmerter					
14. Migrene					
15. Mageknip					

	Ikke plaget	Litt plaget	En del plaget	Alvorlig plaget	Antall dager plagene varte (ca)
16. Magekatarr/magesår	1	2	3	4	5
17. Løs avføring/diare					
18. Hosing/bronkitt					
19. Hodepine					
20. Hjertebank					
21. Helebløtter					
22. Forstoppelse					
23. Forkjølelse/influenza					
24. Eksem					
25. Brystsmerter					
26. Astma					
27. Angst					
28. Allergi					
29. "Lufplager"					



18) Informasjon

Hvor fornøyd er du med informasjon

	Svært fornøyd	Fornøyd	Både og	Misfornøyd	Svært misfornøyd
	1	2	3	4	5
1. ...om farlige forhold på arbeidsplassen?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. ...om forandringer på arbeidsplassen?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. ...om hva som skjer i bedriften?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. ...om det daglige arbeidet?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. ...som blir gitt på sikkerhetsmøtene?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. ...om hvordan uønskede hendelser blir benyttet i videre HMS arbeid?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. ...om risikoomtaler i forbindelse med jobben som skal gjøres?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. ...om beredskapsrutinene i organisasjonen?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. ...om hvilke konsekvenser arbeidet kan ha for din helse?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. ...om hva som skal gjøres dersom en ulykke inntrer?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. ...om dine rettigheter som ansatt i organisasjonen?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. ...om arbeidsoppgavene dine fremover?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. ...om hva som forventes av deg i arbeidet?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. ...om sikkerhet på jobb?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

19) Balanse mellom familie og jobb

	Helt enig	Fornøyd	Både og	Misfornøyd	Svært misfornøyd
	1	2	3	4	5
1. Jeg snakker med familien om arbeidsverdagen min.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Jeg snakker med familien min om jobbprosjekter som krever at jeg bruker ekstra tid på jobben.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Jeg forteller familien min om mindre hyggelige ting som har skjedd på jobben.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Min familie forstår at jeg har forpliktelser som ansatt der jeg jobber.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Familien min forstår hva jobben krever av meg.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Jeg unngår å snakke om jobben når jeg er hjemme.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Familien min er interessert når jeg forteller om jobben min.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

20) Bakgrunnsvariabler

1. Kjønn: Kvinne..... Mann..... 2. Alder: .....

3 Høyeste formelle utdanning

Ungdomsskole..... Fagutdanning som krever offentlig fagbrev.....  
Videregående skole/real skole..... Høyskole eller universitetsutdanning.....

4. Hvor lenge har du vært ansatt i bedriften?

..... år .....

5. Hvor lenge har du vært yrkesaktiv?

..... år .....

6. Hvor stor stillingsandel har du?

..... %

7. I hvilken grad opplever du jobben din som stressende?

I svært liten grad..... I liten grad..... I noen grad..... I liten grad.....

8. Hvordan bedømmer du din helsetilstand generelt?

Svært god..... Nokså god..... God..... Nokså dårlig..... Dårlig.....

9. Ditt ansettelsesforhold i bedriften...

1. Fast? ..... 2. Vikar? ..... 2. Ansatt på prosjekt? ..... 3. ...annet? (Forklar i felte til høyre).....

10. Hva synes du om spørreskjemaet?

Svært fornøyd..... Nokså fornøyd..... Fornøyd..... Misfornøyd..... Svært misfornøyd.....

Plass for kommentarer. Kommenter du bestemte spørsmål er det fint om du oppgir spørsmålsnummer.

TAKK FOR HJELPEN!

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## APPENDIX II

### QUESTIONNAIRES USED IN PAPER II<sup>21</sup>

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<sup>21</sup> The questionnaires in used in paper II are published with the permission from the Norwegian Petroleum Safety Authority (PSA).

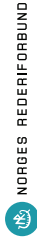
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OLJEDIREKTORATET

# Utvikling i risikonivå på norsk sokkel

## Spørreskjema



### Kjære offshoreansatte

Oljedirektoratet har igangsatt et prosjekt - Utvikling i risikonivå på norsk sokkel - for å kartlegge HMS-tilstanden i norsk offshoreindustri. Prosjektet gjennomføres i nært samarbeid med Sikkerhetsforum som består av representanter fra myndighetene og partene i arbeidslivet.

Hensikten med prosjektet er å følge utviklingen av HMS-tilstanden over tid, og på den bakgrunn iverksette tiltak som kan rette opp eventuelle uheldige utviklingstendenser og generelt bidra til en bedring av HMS i industrien.

Som en del av prosjektet gjennomføres det en spørreskjemaundersøkelse blant offshoreansatte. Spørreskjemaet dekker forhold som:

- Sikkerhetsarbeidet offshore
- Arbeidsmiljøforhold
- Opplevelse av egen helse

Undersøkelsen vil bli gjennomført med jevne mellomrom blant samtlige som reiser offshore i en bestemt periode. I år er alle som reiser offshore i perioden 10. - 21. desember 2001 valgt ut til å delta, og vi ber deg derfor besvare spørsmålene på de neste sidene i løpet av offshoreoppholdet.

**Ferdig utfyllt skjema legges i den vedlagte konvolutten og returneres forseglet til sykepleier før du reiser til land. Eventuelt kan du selv ta skjemaet med til land og poste det der (porto er betalt).**

Rogalandsforskning (RF) er ansvarlig for den praktiske gjennomføringen av spørreskjemaundersøkelsen. Alle skjema vil bli formidlet i uåpnet konvolutt til RF. Skjemaene er konfidensielle, og resultater vil ikke bli presentert på en måte som gjør det mulig å identifisere enkeltpersoner. Alle ved RF som arbeider med undersøkelsen er underlagt taushetsplikt. Løpenummeret øverst på svararkene er kun til administrativ bruk og ikke koplet til noen personidentifikasjon.

Eventuelle spørsmål kan rettes til sykepleier, eller til:

Arne Jarl Ringstad, Rogalandsforskning, tlf. 51875443, e-post: arne.jarl.ringstad@rf.no

Bjørn Arvesen, Rogalandsforskning, tlf. 51875175, e-post: bjorn.arvesen@rf.no

Øyvind Lauridsen, Oljedirektoratet, tlf. 51876021, e-post: oyvind.lauridsen@npd.no

På forhånd tusen takk for hjelpen!

### Viktig:

Skjemaet skal leses maskinelt. Det er derfor viktig at utfyllingen blir nøyaktig utført. Bruk helst blå eller svart penn.

Sett kryss innenfor ruten, slik: ☒ Hvis kryss i feil rute, stryk ut feil svar slik: ☐

Bruk blokkbokstaver ved utfylling av tekstfelt, slik:

M	E	K	A	N	I	K	E	R	
---	---	---	---	---	---	---	---	---	--

12. a) Hvis du arbeider på den samme installasjonen hver tur, hva heter installasjonen?

b) Hvis det varierer hvilken installasjon du arbeider på, hva heter installasjonen du er på nå?

13. Når du er offshore, hvor ofte benytter du helikopter mellom arbeidssted og innkvarteringssted («shutting» til annet overnattingssted offshore eller pendling til land for overnatting på hotell)?

Hver dag	Noen ganger i løpet av et år	Aldri
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

14. Er du pålagt noen av disse beredskapsfunksjonene:

a) Livbåtfører	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>
b) Søkelag	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>
c) Brannlag	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>
d) MOB-båt	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>
e) Førstehjelp	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>
f) Alarmreaksjonslag (ARL)	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>
g) Skadestedsledelse	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>
h) Beredskapsledelse	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>
i) Annet (spesifiser)		

15. Har du for tiden verv som

a) Tillitsvalgt	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>
b) Verneombud	Ja <input type="checkbox"/>	Nei <input type="checkbox"/>

16. Under er det listet opp en del utsagn om forhold av betydning for HMS offshore. Basert på erfaringer fra din arbeidsplass, angi hvor enig du er i de ulike utsagnene ved å krysse av i en boks for hvert utsagn. (Dersom du arbeider på ulike installasjoner, baser svarene dine på det du mener er mest typisk.)

	Helt enig	Delvis enig	Verken enig eller uenig	Delvis uenig	Helt uenig
Risikofylte arbeidsoperasjoner blir alltid nøye gjennomgått før de påbegynnes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jeg er av og til presset til å arbeide på en måte som truer sikkerheten	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Helt enig

Delvis enig

Verken enig eller uenig

Delvis uenig

Helt uenig

Min manglende kjennskap til ny teknologi kan av og til føre til økt ulykkesrisiko	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Av og til arbeider jeg selv om jeg egentlig er for trøtt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bemanningen er tilstrekkelig til at HMS ivaretas på en god måte	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bonusordninger knyttet til få ulykker gir bedre sikkerhet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jeg har den nødvendige kompetansen til å utføre min jobb på en sikker måte	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jeg har lett tilgang til nødvendig personlig verneutstyr	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Innspill fra verneombudene blir tatt seriøst av ledelsen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Det er ofte rotete på min arbeidsplass	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jeg synes det er ubehagelig å påpeke brudd på sikkerhetsreglene	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Man kan lett bli oppfattet som en krangleveren person dersom man påpeker farlige forhold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Jeg kan påvirke HMS-forholdene på min arbeidsplass	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Det hender at jeg bryter sikkerhetsregler for å få jobben fort unna	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
En arbeidsplass med gode HMS-forhold betyr mye for meg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Systemet med arbeidstillatelser blir alltid etterlevd	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Etter min mening er det et for sterkt fokus på sikkerhet i offshoreindustrien	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I praksis går hensynet til produksjonen foran hensynet til HMS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Informasjon om uønskede hendelser blir effektivt benyttet for å hindre gjentakelser	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



17. Under er det listet opp en del fare- og ulykkesituasjoner som kan oppstå offshore. Angi hvor stor fare du opplever at de ulike situasjonene utgjør for deg. Kryss av i en boks for hver situasjon.

	Svært liten fare (1)		(2)	(3)	(4)	(5)	Svært stor fare (6)
Helikopterulykke	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gasslekkasje	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brann	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Utblåsning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Utslipp av giftige gasser/stoffer/kjemikalier	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kollisjoner med skip/fartøy/drivende gjenstander	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sabotasje/terror	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sammenbrudd i installasjonens bærende konstruksjoner eller tap av oppdrift/flyteeвне	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Alvorlig arbeidsulykke	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

18. Under er det listet opp en del forhold som angår fritid og hvileperioder offshore. Angi om du er fornøyd eller misfornøyd med de ulike forholdene ved å krysse av i en boks for hvert forhold.

Offshore fritid/hvileperiode						
	Svært fornøyd	Fornøyd	Verken fornøyd eller misfornøyd	Misfornøyd	Svært misfornøyd	
Støy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Temperatur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Vibrasjoner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Hygiene/renhold/orden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Belysning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Luftkvalitet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Mat/drikkekvalitet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Lugarforholdene	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Treningsmuligheter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Øvrige rekreasjonsmuligheter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

19. Under er det listet opp en del forhold som angår arbeidssituasjonen offshore. Angi om du er fornøyd eller misfornøyd med de ulike forholdene ved å krysse av i en boks for hvert forhold.

Offshore arbeidssituasjon						
	Svært fornøyd	Fornøyd	Verken fornøyd eller misfornøyd	Misfornøyd	Svært misfornøyd	
Støy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Temperatur	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Vibrasjoner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Hygiene/renhold/orden	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Belysning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Luftkvalitet	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Værbeskyttelse	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Håndtering av kjemikalier	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Tunge løft	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Gjentagende (repetitivt) arbeid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Arbeid i forkjærte stillinger	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Arbeidsmengde	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Arbeidstempo	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Skiftordningen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Arbeidsplassens utforming	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

20. Under er det listet opp en del forhold som angår din arbeidssituasjon. Angi om du er fornøyd eller misfornøyd med de ulike forholdene ved å krysse av i en boks for hvert forhold.




	Svært fornøyd	Fornøyd	Verken fornøyd eller misfornøyd	Misfornøyd	Svært misfornøyd	
Anledning til å planlegge eget arbeid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Utviklingsmuligheter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Forhold til kollegaer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Forhold til nærmeste leder	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Måten arbeidet mitt blir verd-satt på	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Arbeidsmiljøet totalt sett	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



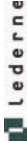


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# Trends in risk level on the Norwegian shelf




OLJEUINDUSTRIENS  
LANDSFØRENING



NORGES REDERIFORBUND



Questionnaire



CONFIDENTIAL

## Dear offshore employee

Since 2000, the Norwegian Petroleum Directorate has been conducting a project: "Trends in risk level on the Norwegian shelf" – to map the HES situation on the Norwegian shelf. The project is conducted in close cooperation with the Safety Forum, which is made up of representatives from relevant authorities, employers and employee organisations.

The purpose of the project is to monitor trends in the HES situation over time, so that measures can be implemented to correct any unfortunate drifts and generally contribute to an improvement in HES within the industry.

As part of this project, a questionnaire is distributed to everyone working offshore, every second year. The questionnaire concerns the HES work offshore, and includes the following issues:

- Safety
- Working environment
- Assessment of one's own health

Please answer the questions on the following pages during your stay offshore.

**Please put your completed form in the enclosed envelope, seal it and hand it to the nurse before going onshore.**

Det Norske Veritas (DNV) and TNS Gallup are in charge of the practical implementation of the survey. All forms will be transferred to TNS Gallup in sealed envelopes. **The forms are confidential, and the results will not be presented in any way which might enable identification of individuals.** All staff at DNV and TNS Gallup who are associated with the survey have a duty to observe confidentiality. The serial number at the top of this sheet is for administrative purposes only and is not linked to any personal identification.

The survey is supported by OFS, DSO, Nopef, Norwegian United Federation of Trade Unions, Lederne, Federation of Oilworkers' Trade Unions, TBL, Norwegian Shipowners' Association and OLF.

OLF has promised a prize of NOK 10,000 to be raffled among the installations with a high reply rate. The money will be used for a welfare measure of the winner's choice.

Please direct any questions you might have to the nurse, or to

Arne Jarl Ringstad, DNV (tel.51506053, e-mail: arne.jarl.ringstad@dnv.com)  
Gunnar Hauland, DNV (tel. 51506052, e-mail: gunnar.hauland@dnv.com)  
Øyvind Lauridsen, OD (tel. 51876021, e-mail: oyvind.lauridsen@npd.no)

Thank you very much for your help.

**Important!** Read before you begin. This form will be read electronically. Therefore, it is important that it is filled in carefully. Please use a blue or black pen.

Place a tick [X] in the box to indicate your answer. If you ticked the wrong box, delete the incorrect answer as indicated: ■

Please use block letters when filling in text fields as indicated:

M	E	C	H	A	N	I	C
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Numbers should be written like this:

0	1	2	3	4	5	6	7	8	9
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1. Sex

Male ☐ Female ☐

2. Age (years)

20 or less ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ 61 or over ☐

3. In the last year, how much of your working time has been spent offshore?

100-75% ☐ 74-50% ☐ 49-25% ☐ 24-0% ☐

4. Please indicate the total number of years that you have spent offshore (all or sometime)?

0-1 ☐ 2-5 ☐ 6-10 ☐ 11-20 ☐ over 20 ☐

5. Please state the total number of years in your present position

0-1 ☐ 2-5 ☐ 6-10 ☐ 11-20 ☐ over 20 ☐

6. What company are you employed in?

7. What is your position title?

8. What area do you work in (if you work in several areas, select the one you think best fits your position)?

Process	Drilling	Well service	Catering	Construction/ modification	Maintenance	Crane/ deck	Other
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

9. Do you have line manager responsibilities?

Yes ☐ No ☐

10. Do you work a permanent offshore rotation?

Yes ☐ No ☐

11. Currently, what type of shift arrangement are you working under?

Permanent day shift	Permanent night shift	Fixed shift (14 nights/14 days every second tour)	Swing shift with seven nights first, then seven days	Swing shift with seven days first, then seven nights	Shift arrangement vary
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

12. a) What is the name of the installation you are working on currently?

b) Do you work permanently on this installation?

Yes, each tour ☐ Yes, mostly ☐ No, it varies ☐

13. During a typical work period, how often do you travel by helicopter between your place of work and your accommodation ("shuttling" to other accommodation offshore or commuting onshore for hotel accommodation)?

Always/ nearly always <input type="checkbox"/>	A few times during a work period <input type="checkbox"/>	Never/ virtually never <input type="checkbox"/>	Varies greatly from one period to the next <input type="checkbox"/>
--	---	---	---

14. Do you have any of these emergency preparedness functions:

a) Lifeboat coxswain	Yes <input type="checkbox"/> No <input type="checkbox"/>
b) Fire team	Yes <input type="checkbox"/> No <input type="checkbox"/>
c) Man-over-board boat (MOB boat)	Yes <input type="checkbox"/> No <input type="checkbox"/>
d) First aid	Yes <input type="checkbox"/> No <input type="checkbox"/>
e) Helicopter landing officer (HLO)	Yes <input type="checkbox"/> No <input type="checkbox"/>
f) Rescue leader	Yes <input type="checkbox"/> No <input type="checkbox"/>
g) Emergency team leader	Yes <input type="checkbox"/> No <input type="checkbox"/>
h) Other (please specify)	Yes <input type="checkbox"/> No <input type="checkbox"/>

15. Do you currently hold the office of

a) Employee representative	Yes <input type="checkbox"/> No <input type="checkbox"/>
b) Safety delegate	Yes <input type="checkbox"/> No <input type="checkbox"/>
b) Member of working environment committee	Yes <input type="checkbox"/> No <input type="checkbox"/>

16. Have you conducted the 40-hour basic course for safety delegates and members of working environment committees?

Yes ☐ No ☐

17. During the last year, have you experienced reorganisations with considerable consequences for how you plan and/or carry out your work tasks?

Yes ☐ No ☐

**18. Statements concerning matters of importance to Health, Environment and Safety (HES) are listed below. Based on experiences from your place of work, please indicate to what extent you agree/disagree. Tick only one box for each statement. (If you work on different installations, please provide an answer that is most typical.)**

	Agree totally	Agree partly	Neither agree nor disagree	Disagree partly	Disagree totally
Risk-filled operations are always carefully planned before they are started	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
At times, I am pressured to work in a way that jeopardises safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My lack of knowledge concerning new technology may sometimes lead to an increased accident risk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sometimes I work even if I am too tired	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The manning is sufficient for HES to be safeguarded in a good manner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have the necessary competence to conduct my job in a safe manner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have easy access to the required personal protective equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The management takes suggestions from safety delegates seriously	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My work place is often messy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel uncomfortable pointing out breaches in safety rules	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The work permit system is always followed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can influence HES matters in my place of work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I sometimes breach safety rules in order to get a job done quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is important to me to work in a place with good HES conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
One can easily be regarded as a "troublemaker" when pointing out hazardous situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Agree totally	Agree partly	Neither agree nor disagree	Disagree partly	Disagree totally
In real life, production considerations takes precedence over HES considerations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information on undesirable incidents are used effectively to prevent recurrences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I use the compulsory personal protective equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do not participate actively in safety meetings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Being too keen on HES is a disadvantage for my career	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Communication between me and my colleagues often break down in a manner which may cause hazardous situations to arise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Laws and regulations concerning HES are not good enough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I would rather not discuss HES matters with my immediate superior	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Deficient maintenance has led to poorer safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I stop working if I feel it might be dangerous for me or others to continue	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My manager appreciates me pointing out matters of importance for HES	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have received sufficient HES training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My colleagues stop me if I am working in an unsafe manner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I doubt that I will be able to carry out my emergency preparedness tasks in a crisis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There are often several operations going on at the same time, which may lead to dangerous situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our accident preparedness plan is good	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Accidents or hazardous situations are often made to look less serious on reports	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I ask my colleagues to stop any work that I feel is conducted in a dangerous manner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The company where I work takes HES seriously	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Deficient cooperation between operators and contractors often lead to hazardous situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I report hazardous situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safety is my top priority as I carry out my job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My manager is involved in the HES work on the installation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is easy to tell the nurse/ company health service about complaints and illnesses that may be work-related	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My colleagues are very interested in HES	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am unsure about my role in the emergency preparedness organisation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The safety delegates do a good job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I think it is easy to find what I am looking for in governing documents (requirements and procedures)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I know who I am supposed to report to in the organisation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The HES procedures cover my work tasks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Different procedures and routines on different installations may pose a threat to safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel sufficiently rested when I am working	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The equipment I need to carry out my tasks safely is easily accessible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**19. Hazardous situations and accidents that may occur offshore are listed below. Please indicate how large a threat these various situations represent to you. Tick only one box for each situation.**

	Very little threat (1)	(2)	(3)	(4)	(5)	Very large threat (6)
Helicopter accident	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Gas leak	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fire	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blowout	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Emission/discharge of poisonous gases /substances/chemicals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collisions with ships/vessels/ floating objects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sabotage/terror	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collapse in the installation's load-bearing structures or loss of buoyancy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other work accidents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**20. Issues related to your free periods offshore are listed below. Please indicate whether you are satisfied or unsatisfied regarding these various issues. Tick only one box for each issue.**

Offshore free period	Very satisfied	Satisfied	Neither satisfied nor unsatisfied	Unsatisfied	Very unsatisfied
Noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Temperature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vibrations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cleaning/tidiness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lighting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Air quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Quality of food and drink	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cabin conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exercise opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other recreational opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Helicopter transport					
Comfort during helicopter transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**21. Issues related to your work situation offshore are listed below. Please indicate whether you are satisfied or unsatisfied regarding the various issues. Tick only one box for each issue.**

Offshore work time	Very satisfied	Satisfied	Neither satisfied nor unsatisfied	Unsatisfied	Very unsatisfied
Noise	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Temperature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vibrations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cleanliness/tidiness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lighting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Air quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Protection against weather	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Handling of chemicals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Heavy lifting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Repetitive work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Working in uncomfortable positions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Amount of work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Working speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shift arrangement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work place design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**22. Issues related to your work situation are listed below. Please indicate whether you are satisfied or unsatisfied with the various issues. Ticking only one box for each issue.**

	Very satisfied	Satisfied	Neither satisfied nor unsatisfied	Unsatisfied	Very unsatisfied
Opportunity to plan my own work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Opportunities for personal development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Relationships to colleagues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Relationship to immediate superior	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How my work is valued	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Climate of cooperation between employees of different companies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Job security	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Overall working environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**23. Statements about sleep and rest are listed below. Please indicate how often the various statements represent what you feel. Tick only one box for each statement.**

	Nearly always	Mostly	Sometimes	Rarely	Hardly ever
I sleep well offshore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I sleep well the last few nights before going offshore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I sleep well the first few nights after an offshore tour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Noise is a problem for me when I have to sleep offshore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
When I sleep I have to share a cabin with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**24. How many hours were you awake before going on your first shift? Approx.   hours**

**25. How much overtime did you work on your last tour? Approx.   hours**

**26. How many days did you spend offshore on you last tour? Approx.   days**

**27. Have you (once or several times during this last year) worked for more than 16 hours in the course of a 24-hour period offshore?**  
Yes ☐ No ☐

**28. Have you been absent from work during this last year because of illness?**

Yes ☐ No ☐

**29. If you ticked yes to the last question, please also answer:**

**How many days during this last year have you been absent from work due to illness?**

1-14 days ☐ More than 14 days ☐

**Do you feel this absence was caused partly or totally by your work situation?**

Yes ☐ No ☐

30. Have you been troubled by any of the following symptoms/problems during the last three months:

- |   |                          |                          |    |
|---|--------------------------|--------------------------|----|
| a) Reduced hearing                              | <input type="checkbox"/> | <input type="checkbox"/> | No |
| b) Buzzing in the ears                          | <input type="checkbox"/> | <input type="checkbox"/> | No |
| c) Muscle or bone complaints                    | <input type="checkbox"/> | <input type="checkbox"/> | No |
| d) Skin complaints                              | <input type="checkbox"/> | <input type="checkbox"/> | No |
| e) Allergic reactions/hypersensitivity          | <input type="checkbox"/> | <input type="checkbox"/> | No |
| f) Respiratory problems                         | <input type="checkbox"/> | <input type="checkbox"/> | No |
| g) Cardiovascular problems                      | <input type="checkbox"/> | <input type="checkbox"/> | No |
| h) Psychological problems (anxiety, depression) | <input type="checkbox"/> | <input type="checkbox"/> | No |

**31. How would you describe your health in general?**

Very good	Good	Neither particularly good or poor	Poor	Very poor
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**32. Certain activities that are part of many offshore jobs are listed below. Please indicate whether your state of health restricts from the following activities. Tick only one box for each activity.**

	My health does not restrict me	My health restricts me a little	My health restricts me a lot
Walking on hard floors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walking on stairs and ladders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sitting in the same position for a long time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Kneeling, squatting, bending down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lifting heavy objects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contact with common substances/chemicals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Understanding what others are saying	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**33. Please use the space below to comment on issues raised in this questionnaire:**



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## APPENDIX III

### QUESTIONNAIRE USED IN PAPER III<sup>22</sup>

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<sup>22</sup> The questionnaire is published with the permission from the Norwegian Petroleum Safety Authority (PSA).

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# Trends in risk level on the Norwegian shelf



## Questionnaire

**CONFIDENTIAL**



## Dear offshore employee

Since 2000, the Petroleum Safety Authority Norway has been conducting a project: "Trends in risk level on the Norwegian shelf" – to map the HSE situation on the Norwegian shelf. The project is conducted in close cooperation with the Safety Forum, which is made up of representatives from relevant authorities, employers and employee organizations. The following organizations are members of the Safety Forum: DSO, Norwegian United Federation of Trade Unions, Lederne, the Norwegian Federation of Trade Unions, NOPEF, Norwegian Shipowners' Association, Norwegian Industry, OLF, Confederation of Employees in the Private Sector/YS and SAFE.

The purpose of the project is to monitor trends in the HSE situation over time, so that measures can be taken to correct any unfortunate drifts and contribute to improvements in HSE in the industry.

As part of this project, a questionnaire is distributed to everyone working offshore, every second year.

The questionnaire applies to HSE work offshore, and includes the following issues:

- Safety
- Working environment
- Assessment of one's own health

Please answer the questions on the following pages during your stay offshore.

**Please put your completed form in the enclosed envelope, seal it and deliver it to the nurse before going onshore.**

IRIS (a R&D company established by RF-Rogaland Research and the University of Stavanger) in cooperation with Sentio AS are in charge of the practical implementation of the survey. All forms will be transferred to Sentio AS in sealed envelopes. **The forms are confidential, and the results will not be presented in any way which might enable identification of individuals.** All staff at IRIS and Sentio who are associated with the survey have an obligation to observe confidentiality.

**You will need the serial number at the top of the next sheet if you wish to fill in this questionnaire on the internet. The serial number is for administrative purposes only and is not linked to any personal identification. Type the following link into the browser:**  
**<http://easysurvey.sentio.no/rnms>**

**Follow the instructions for filling in the form electronically. If you have filled in the form on the internet, there is no need to submit the form. You may therefore keep this form for your own information, or dispose of it.**

Please direct any questions you might have to the nurse, or to

Kirsten Allred, IRIS, (tel 51 87 50 85, e-mail: [kirsten.allred@rf.no](mailto:kirsten.allred@rf.no))

Øyvind Lauridsen, Petroleum Safety Authority (tel 51 87 60 21, e-mail: [oyvind.lauridsen@ptil.no](mailto:oyvind.lauridsen@ptil.no))

Roar Håskjold, Sentio AS (tel 905 48 892, e-mail: [roar@sentio.no](mailto:roar@sentio.no))

Thank you very much for your help!

**Important!** This form will be read electronically. Therefore, it is important that it is filled in carefully. Please use a blue or black pen.

Place a tick ☒ in the box to indicate your answer. If you ticked the wrong box, delete the incorrect answer as indicated: ■ Please use block letters when filling in text fields as indicated:

M	E	C	H	A	N	I	C
---	---	---	---	---	---	---	---

Numbers should be written like this:

0	1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---	---

\_\_\_\_\_

[illegible][illegible]

	Fully agree	Partially agree	Neither agree nor disagree	Partially disagree	Fully disagree
My lack of knowledge concerning new technology may sometimes lead to an increased accident risk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The manning is sufficient for HSE to be safeguarded in a good manner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have the necessary competence to conduct my job in a safe manner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have easy access to required personal protective equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have received sufficient safety training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The management takes suggestions from safety delegates seriously	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My work place is often messy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel uncomfortable when pointing out breaches in safety rules	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The work permit system is always followed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can influence HSE matters in my place of work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I sometimes breach safety rules in order to get a job done quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
In practice, production always takes priority over HSE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Information about undesired incidents is used efficiently to prevent re-occurrences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I use the mandatory personal protection equipment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I do not actively participate at HSE meetings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Career wise, it can be a disadvantage to be too preoccupied with HSE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Communication between me and my colleagues often fails in a way that may lead to dangerous situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The laws and regulations for HSE are not good enough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Fully agree	Partially agree	Neither agree nor disagree	Partially disagree	Fully disagree
I would rather not discuss HSE matters with my immediate supervisor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inadequate maintenance work has led to a deterioration of the safety level	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I stop work if I feel it may be dangerous for myself or others to carry on	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My manager appreciates my pointing out matters of importance to HSE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have been given adequate training in work environment issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My colleagues will stop me if I work unsafely	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I doubt that I will be able to perform my emergency preparedness tasks in an emergency situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
There are often concurrent work operations which lead to dangerous situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The accident preparedness is good	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accidents or hazardous situations are often made to look less serious on reports	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I ask my colleagues to stop any work that I feel is conducted in an unsafe manner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The company I work for takes HSE seriously	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of cooperation between operators and contractors often leads to hazardous situations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
If I see hazardous situations I report them	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safety is my top priority when I carry out my job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
My supervisor is actively involved in the HSE work on the installation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is easy to tell the nurse/company health service about complaints and illnesses that may be work-related	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Fully agree	Partially agree	Neither agree nor disagree	Partially disagree	Fully disagree
My colleagues are extremely conscious of HSE issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I am unsure about my role in the emergency preparedness organization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The safety delegates do a good job	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
It is easy to find what I look for in the governing documents (requirements and procedures)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I always know who I am supposed to report to in the organization	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The HSE procedures cover my work tasks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Different procedures and routines on different installations may pose a threat to safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I feel sufficiently rested when I am at work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The equipment I need to carry out my tasks safely is easily accessible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

21. Hazardous situations and accidents that may occur offshore are listed below. Please indicate how great of a threat you perceive these situations to be. Tick only one box for each situation.

[illegible]

Offshore free period	Very rarely or never	Relatively seldom	Some times	Quite often	Very often or always
Is there a disturbing noise level in the public rooms of the accommodation quarters?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is there a disturbing noise level in your cabin?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you find the indoor climate poor in the public areas of the accommodation quarters?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is the air in your cabin poor?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are the living quarters clean and tidy?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**23. Please indicate to what degree you are satisfied or unsatisfied with the issues below. Tick only one box for each situation.**

Offshore free period	Very satisfied	Satisfied	Neither satisfied nor unsatisfied	Unsatisfied	Very unsatisfied
Quality of food and drink	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cabin conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exercise opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other recreational opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Comfort during helicopter transport	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**24. Issues related to your work situation offshore are listed below. Please indicate your experience of the various issues. Tick only one box for each issue.**

Offshore work time	Very rarely or never	Relatively seldom	Some times	Quite often	Very often or always
Are you exposed to a noise level that is so high that you have to stand close to other people and shout to be heard or use a headset?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Very rarely or never	Relatively seldom	Some times	Quite often	Very often or always
Are you exposed to vibrations to your hands or arms from machines or tools?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you work in cold areas exposed to the weather?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are you exposed to a poor indoor climate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you ever have difficulties seeing what you are doing because of insufficient, weak or blinding lights?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is your skin exposed to contact with e.g. oil, drilling mud, detergents or other chemicals?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can you smell chemicals or clearly see dust or smoke in the air?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you do heavy lifting?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you do repetitive and monotonous movements?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you work in difficult work positions (e.g. with arms above the shoulders, a bent or twisted back or neck)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is it necessary to work very fast?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you find the shift arrangement burdensome?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is your work place well adapted to the tasks you perform?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does your work require you to be so attentive that you feel it is a strain?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is your work challenging in a positive way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Does your work require you to attain new skills and knowledge?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are your work achievements appreciated by your immediate leader?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Can you set your own work speed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Very rarely or never	Relatively seldom	Some times	Quite often	Very often or always
Do you have influence on decisions of importance to your work?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you have any influence on how you perform your work?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you get support and help with your work from your colleagues if you need it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you get support and help with your work from your immediate leader if you need it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you feel that the working climate in your work unit is supportive and encouraging?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you have so many tasks to do that it is difficult to concentrate on each task?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you get feed-back on your work performance from your immediate leader?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Do you feel sure that you will have a job in two years that is as good as your present one?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<p><b>25. Have you been exposed to repeated bullying or harassment at your workplace during the past six months?</b></p> <p>Yes <input type="checkbox"/> No <input type="checkbox"/></p>					
<p><b>26. Statements about sleep and rest are listed below. Please indicate how often the various statements represent what you feel. Tick only one box for each statement.</b></p>					
I sleep well offshore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I sleep well the last few nights before going offshore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I sleep well the first few nights after an offshore tour	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Noise is a problem for me when I have to sleep offshore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
When I sleep I have to share a cabin with others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

27. How many hours were you awake before going on your first shift? Approx.   hours
28. How much overtime did you work on your last tour? Approx.   hours
29. How many days did you spend offshore on your last tour?   days
30. Have you (once or several times during this last year) worked for more than 16 hours in the course of a 24-hour period offshore? Yes ☐ No ☐
31. During your last offshore tour, were you woken up on your free time to do a job? Yes ☐ No ☐
32. Do you as a rule have one or more additional jobs onshore in between offshore tours? Yes ☐ No ☐
33. Have you been absent from work during this last year because you have been ill? Yes ☐ No ☐

34. If you ticked yes to the last question, please also answer:  
How many days during this last year have you been absent from work due to illness?

1-14 days ☐ More than 14 days ☐

Do you feel this absence was caused partly or totally by your work situation?

Yes ☐ No ☐

35. While working offshore this last year, have you been a victim of a work accident?

Yes ☐ No ☐

36. If you ticked yes to the last question, please also answer:

Was your injury reported to the nurse or your supervisor?

Yes ☐ No ☐

If it was reported, please state how your injury was classified:

Examination only	First aid	Medical treatment	Alternative work	Absence due to injury	Serious personal injury
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

37. Working capacity

Very good	Fairly good	Moderate	Fairly poor	Very poor
-----------	-------------	----------	-------------	-----------

How would you describe your work capacity with respect to the physical demands at work?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

How would you describe your work capacity with respect to the mental demands at work?

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------	--------------------------	--------------------------

9

38. Have you been troubled by any of the following symptoms or problems during the last three months:

Reduced hearing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buzzing in the ears	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Headaches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pain to the neck/shoulders/arms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Back pains	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pains to the knees/hips	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Eye problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skin complaints (eczema, rashes)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Allergic reactions / hypersensitivity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Respiratory problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cardiovascular problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Psychological problems (anxiety, depression, sadness, restlessness)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Tick here if you feel that your symptoms are fully or partially caused by your working situation

39. How would you generally describe your health?

Very good	Good	Neither good nor poor	Poor	Very poor
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

40. Please use the space below to comment on issues raised in this questionnaire:



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## APPENDIX IV

### QUESTIONNAIRE USED IN PAPER IV<sup>23</sup>

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<sup>23</sup> The questionnaire used in paper IV is published with the permission from Espen Olsen at the University of Stavanger.

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Skjemanummer	
Prosjekt	7302773

**Til alle som har deltatt på aktiviteter i forbindelse med Kollegaprogrammet**

Rogalandforskning er ansvarlig for analysen av spørreskjemaene, og alle svar vil bli behandlet konfidensielt og anonymisert i framstillingen av resultater. I praksis vil dette si at det ikke vil bli fremstilt resultater for grupper på mindre enn fem personer.

Ta stilling til spørsmålene i skjemaet med utgangspunkt i den arbeidsplassen der du er nå. Ferdig utfyllt skjema legges i den vedlagte svarkonvolutten og postlegges. Porto er betalt.

Svarene dine skal leses inn optisk, så det er viktig at du er nøye med utfyllingen. Bruk helst blå eller svart penn, og skriv tydelig i de åpne feltene.

Sett kryss i rutene, slik: ☒ Dersom du krysser i feil rute, stryk ut feil svar slik: ☐

**Spørsmål om undersøkelsen kan rettes til:**

Espen Olsen, Rogalandsforskning, tlf. 51 87 50 72, e-post: eo@rf.no

Anita Eide, Statoil, tlf. 91 69 18 29, e-post: [anei@statoil.com](mailto:anei@statoil.com)

## Bakgrunnsinformasjon

<b>1</b>	<b>Alder</b>	20 år eller yngre <input type="checkbox"/> 1
		21-30 år <input type="checkbox"/> 2
		31-40 år <input type="checkbox"/> 3
		41-50 år <input type="checkbox"/> 4
		51-60 år <input type="checkbox"/> 5
		61 år eller eldre <input type="checkbox"/> 6
<b>2</b>	<b>Hvilket område arbeider du innenfor?</b>	Prosess <input type="checkbox"/> 1 Boring <input type="checkbox"/> 2 Brennservice <input type="checkbox"/> 3 Forpleining <input type="checkbox"/> 4 Konstruksjon/modifisering <input type="checkbox"/> 5 Vedlikehold <input type="checkbox"/> 6 Kran/dekk <input type="checkbox"/> 7 Annet <input type="checkbox"/> 8
<b>3</b>	<b>Arbeider du på land eller sokkel?</b>	Land <input type="checkbox"/> 1 Sokkel <input type="checkbox"/> 2

4	Har du lederansvar?	Nei <input type="checkbox"/> 1 Ja <input type="checkbox"/> 2
5	Har du deltatt på samling med kollegaprogrammet på Clarion hotell?	Ja <input type="checkbox"/> 1 Nei <input type="checkbox"/> 2
6	Hvis "Nei", hopp til spørsmål 7	
	Hvis "Ja", på forrige spørsmål, når deltok du på samlingen?	
	3. kvartal 2003	<input type="checkbox"/> 1
	4. kvartal 2003	<input type="checkbox"/> 2
	1. kvartal 2004	<input type="checkbox"/> 3
	2. kvartal 2004	<input type="checkbox"/> 4
	3. kvartal 2004	<input type="checkbox"/> 5
	4. kvartal 2004	<input type="checkbox"/> 6
	Annet tidsrom	<input type="checkbox"/> 7

7	Hvor er du ansatt?	Statoff	<input type="checkbox"/> 1
		Boreenrepentør	<input type="checkbox"/> 2
		Brennservicelskap	<input type="checkbox"/> 3
		Vedlikehold og modifikasjon	<input type="checkbox"/> 4
		Annet	<input type="checkbox"/> 5

8	Hvor arbeider du nå	Snorre A	<input type="checkbox"/> 01
		Snorre A landorganisasjon	<input type="checkbox"/> 02
		Norne	<input type="checkbox"/> 03
		Norne landorganisasjon	<input type="checkbox"/> 04
		Gullfaks C	<input type="checkbox"/> 05
		Gullfaks C landorganisasjon	<input type="checkbox"/> 06
		Heldrun	<input type="checkbox"/> 07
		Heldrun landorganisasjon	<input type="checkbox"/> 08
		Troll A	<input type="checkbox"/> 09
		Kvitbjørn	<input type="checkbox"/> 10
		TKV landorganisasjon	<input type="checkbox"/> 11
		Kollnes	<input type="checkbox"/> 12
		T-S FUT	<input type="checkbox"/> 13
		T-S DVM	<input type="checkbox"/> 14

## Erfaringer etter Kollegaprogrammet

## Personlig

**9** Hvordan vurderer du egen sikkerhedsadferd efter Kollegaprogrammet?

Dårligere eller Kollega programmet = 1 - 2, Som før = 3 - 4, Bedre etter programmet = 5 - 6

[illegible]

10 Hvordan vurderer du dine kollegers sikkerhetsadferd etter Kollegaprogrammet?

Dårligere etter Kollegaprogrammet = 1 - 2, Som før = 3 - 4, Bedre etter programmet = 5 - 6

Oppmerksomhet på risiko i jobben	1	2	3	4	5	6	1
At de bryr seg om arbeidskolleger							2
Utføring av lagende risikovurderinger							3
Efterlevelse av prosedyrer							4
Ha åpen dialog om risikoforhold							5
Prioritering av sikkerhet							6
Ta initiativ for å bedre sikkerheten							7
Tar opp sikkerhetstiltak på HMS-møter							8
Tar initiativ dersom andre ikke jobber sikkert							9
Aksepterer "sille" avvik							10
Planlegging av arbeid							11
Samarbeid med andre om tilrettelegging av arbeidst							12
Er positive til Åpen Sikkerhetssamtale (ASS)							13
Gjennomføring av Sikker Jobb Analyse (SJA)							14

Ledelse

11 Hvordan vurderer du din nærmeste leders sikkerhetsadferd etter Kollegaprogrammet?

SETT BARE ETT KRYSS PR LINJE

	I svært liten grad	I liten grad	I mindre grad	I noen grad	I stor grad	I svært stor grad
Min nærmeste leder viser i praksis at han/hun føler bedre å bli korrigert	1	2	3	4	5	6
Jeg opplever at min nærmeste leder tar budskapet i Kollegaprogrammet på alvor						1
Kollegaprogrammet har påvirket min nærmeste leder til å i større grad personlig demonstrere god sikkerhetsadferd						2
Kollegaprogrammet har bidratt til at min nærmeste leder i større grad oppfordrer oss til å ta sikkerhetsinitiativ						3
						4

12

Tillitsvalgte på min arbeidsplass engasjerer seg i gjennomføringen av Kollegaprogrammet	1	2	3	4	5	6	Helt enig
Kollegaprogrammet har bidratt til å heve sikkerheten der jeg jobber							1
Kollegaprogrammet har bidratt til å redusere uønskede hendelser i avdelingen min							2
Kollegaprogrammet har bidratt til å bedre sikkerhetskulturen i Statol							3
Kollegaprogrammet har bidratt til å bedre sikkerhetskulturen hos Statol sine leverandører							4
Jeg opplever at tilpølelsen i selskapet i seg jobber i tar budskapet i Kollegaprogrammet på alvor							5
Verneombudene på min arbeidsplass engasjerer seg i gjennomføringen av Kollegaprogrammet							6
Jeg har en positiv opplevelse av Kollegaprogrammet							7
Alt i alt synes jeg det er god sikkerhet der jeg jobber							8
Alt i alt trives jeg godt i min jobb							9
							10

Kollegagruppen

Kollegagruppen = Stedlig hovedverneombud/VO, HMS-koordinator og enhetens leder (feks plattformsjef)

13 Nedenfor følger noen utsagn som gjelder dine inntrykk av Kollegagruppen

	I svært liten grad	I svært stor grad	I svært liten grad	I svært stor grad	I svært liten grad	I svært stor grad
Kollegagruppen har bidratt til å heve sikkerheten der jeg jobber	1	2	3	4	5	6
Jeg opplever positiv omtale av kollegagruppen blant dem jeg jobber med						1
Kollegagruppen har vært gode veiledere til videreutviklingen av programmet der jeg jobber						2
						3

Samlinger og oppfølging

14 Hvor fornøyd er du i forbindelse med følgende aspekt ved Kollegaprogrammet?

	Svært misfornøyd	Svært fornøyd	Svært misfornøyd	Svært fornøyd	Svært misfornøyd	Svært fornøyd
Innledende samling (to-dagers samling på Clarion hotell)	1	2	3	4	5	6
Allmøte på arbeidsplassen, etter samlingen						1
Utarbeidelsen av tiltak for å fjerne hindringene i ulykkesbarrieren "omtanke for hverandre"						2
Nyften av brosjyrer og plakater						3
Barriereskiven "omtanke for hverandre"						4
Filmene						5
						6

15

I forbindelse med Kollegaprogrammet: Har du laget egne personlige forpliktelser for hvordan du skal ta imot omtanke fra dine kollegaer?

Ja, skriftlig

1

Ja, men ikke skriftlig

2

Nei

3

Nei

4

16

Har du snakket med andre kolleger om din personlige forpliktelse?

Ja, flere ganger

1

Ja, noen ganger

2

Ja, en gang

3

Nei

4

17

Har du fulgt opp din personlige forpliktelse

Ja, ofte

1

Ja, men ikke ofte

2

Ja, men sjelden

3

Nei, aldri

4

Hvis "Nei", gå til spørsmål 18

18

Hvilke faktorer mener du er viktige for at Kollegaprogrammet skal heve sikkerheten der du jobber?

I svært liten grad

1

2

3

4

5

6

1

At toppledelsen i mitt selskap forplikter seg til Kollegaprogrammet

1

At min nærmeste leder forplikter seg til Kollegaprogrammet

2

At leverandører deltar på Kollegaprogrammet

3

At egne bidrag er i samsvar med Kollegaprogrammet

4

At verdien i programmet er gode nok i seg selv

5

At programmet har betydning for måten vi jobber på

6

19

Jeg kjenner til at budskapene i Kollegaprogrammet er jobbet med:

Ikke i det hele tatt

1

2

3

4

5

6

1

Svært ofte

1

2

3

4

5

6

1

Siste spørsmål gjelder ikke ansatte i Statoil

21

Nedenfor følger noen vanlige hindringer for å si fra dersom kolleger tar sjanser som gjelder sikkerheten. I hvilken grad passer disse for deg i din arbeidssituasjon i dag?

1

2

3

4

5

6

1

Jeg er redd for å dumme meg ut fra til

1

Jeg er redd for å dumme meg ut fra til ledere enn til kolleger

2

Jeg er redd for negative konsekvenser

3

Jeg er redd for å såre noen

4

Jeg har liten erfaring med å si fra

5

6

22

Har du det siste året vært involvert i en arbeidsoperasjon hvor du har tatt initiativ til å stoppe opp for å prioritere sikkerheten

Ja

1

2

3

4

5

6

1

Nei

1

2

3

4

5

6

1

23

Hvordan passer Kollegaprogrammet inn i forhold til tilsvarende program du har deltatt på i selskapet du jobber i?

Går i samme retning

1

Supplerer ved å ta opp andre tema

2

Kommer i konflikt

3

Neitralt

4

Takk for at du tok deg tid til å fylle ut skjema!

15

I forbindelse med Kollegaprogrammet: Har du laget egne personlige forpliktelser for hvordan du skal ta imot omtanke fra dine kollegaer?

Ja, skriftlig

1

Ja, men ikke skriftlig

2

Nei

3

Nei

4

16

Har du snakket med andre kolleger om din personlige forpliktelse?

Ja, flere ganger

1

Ja, noen ganger

2

Ja, en gang

3

Nei

4

17

Har du fulgt opp din personlige forpliktelse

Ja, ofte

1

Ja, men ikke ofte

2

Ja, men sjelden

3

Nei, aldri

4

Hvis "Nei", gå til spørsmål 18

18

Hvilke faktorer mener du er viktige for at Kollegaprogrammet skal heve sikkerheten der du jobber?

I svært liten grad

1

2

3

4

5

6

1

At toppledelsen i mitt selskap forplikter seg til Kollegaprogrammet

1

At min nærmeste leder forplikter seg til Kollegaprogrammet

2

At leverandører deltar på Kollegaprogrammet

3

At egne bidrag er i samsvar med Kollegaprogrammet

4

At verdien i programmet er gode nok i seg selv

5

At programmet har betydning for måten vi jobber på

6

19

Jeg kjenner til at budskapene i Kollegaprogrammet er jobbet med:

Ikke i det hele tatt

1

2

3

4

5

6

1

Svært ofte

1

2

3

4

5

6

1

20

Er leverandører mer eller mindre engasjerte i sikkerhetsarbeidet enn ansatte i Statoil?

Leverandører er mer engasjert enn ansatte i Statoil

1

2

3

4

5

1

Begge er like engasjert

1

Begge er ikke engasjert

2

Leverandører er mindre engasjert enn ansatte i Statoil

3

4

5

1

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## APPENDIX V

### INTERVIEWS CONDUCTED IN A PARALLEL TASK

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## **Interviews**

Semi-structured interviews with personnel safety representatives were conducted in a parallel task to the thesis. These interviews are not part of the papers of the thesis; nevertheless, they inspired the discussion concerning HSE culture/climate.

The purpose of these interviews was to examine the composite HSE culture/climate concept in more detail and also to highlight challenges related to HSE work in the workplace. The interviews also directed the focus toward the assumed relationship between perceptions of the work environment, more specifically the psychosocial aspects of the work environment and resulting employee ill health.

The interviews were conducted using a semi-structured interview guide. The interviewees were personnel safety representatives taking part in an HSE conference in a large operator company (N=6). Of the interviewees, 4 were male and 2 were female, they were approximately 40 years of age, and represented different types of occupational groups employed onboard an offshore oil installation (e.g. accommodation personnel and process technicians). They worked on different installations, varying in size, maturity, and activity. Personnel safety advisors were interviewed because of their engagement to matters related to HSE, based on the fact that they take on the formal duties voluntarily. They also attend safety meetings conducted onboard the different platforms. Furthermore, personnel safety representatives have formal duties concerning HSE within the organization. These duties mainly involve representing the workers' interests in matters related to HSE.

### ***Results from the interviews***

All of the interviewed safety deputy officers stated that they chose the responsibility of a personnel safety officer due to their own personal interest. One respondent said, "I have always been interested in matters concerning HSE, and furthermore I think it is vitally important that we as workers show an interest in matters related to our job". Another person highlighted the fact that the safety deputies have a unique opportunity to influence matters related to HSE, i.e. to "do something when you see that something is wrong". Moreover, they highlighted the fact that if you wanted an

influence over your work environment it was perceived as “a duty” to be engaged and to try to influence the decisions being made within the workplace.

Generally, the safety deputies were satisfied with how the company treated HSE aspects, and there was agreement among them that both the work environment offshore and the safety work had improved vastly during the last years. Furthermore, all of the respondents agreed that the company that employed them treated HSE in a serious manner. However, they all mentioned money as a significant factor in the HSE work. One respondent stated that he was not satisfied with how closely the matters of HSE and money were treated and said that “you have to make such a good case for a specific venture if it costs the company money ... even if you know that it will benefit both the workers and the company in the long run”. Another personnel safety representative said that it was no problem obtaining money if the objective was to keep the installation running, and hence the production up, but that it was much harder if they had to argue for psychosocial measures to be conducted within the workplace.

Management was another significant factor that was mentioned in the interviews. The personnel safety representatives specifically underlined that managers have to be committed to HSE work in practice, and that they have to “walk the talk”, i.e. show what they mean/believe in practice. However, one personnel safety representative mentioned that managers also need to be willing to spend money in order to improve the psychosocial work environment. Generally, the personnel safety representatives felt that HSE was treated seriously by the management, and that they were listened to when they “confronted” the management with aspects of the work situation that they felt were important for maintaining the HSE status within the workplace. Communication between the workers and the supervisors was also highlighted as an important issue related to the HSE situation offshore. One personnel safety representative stated that the communication between the operative management and the employees had improved during the last few years and moreover that this had a positive effect on the employees in terms of health and well-being at work. Related to this, one respondent stated that the cooperation between different departments or work groups had improved during the last years, and that the case was the same regarding cooperation between contractors and operators present at the installation.

The personnel safety representatives recognized that the offshore work environment is different from most other work environments onshore. They emphasized that in a regular job onshore you can go home after eight hours and be able to talk to your family and friends about experiences within the workplace, and in a way “blow out steam” that is not possible offshore. One personnel safety representative described the offshore work environment as very intense and as a small community where you have to live and take care of each other for a fortnight. On the other hand, they considered this closeness to be one of the major advantages to offshore safety work in that it is possible to see whether a person has had a bad day or not because they know each other so well. One respondent stated that “the work environment, and the relationship between co-workers ... that is what constitutes the culture out there ... it is reflected in the fact that we can talk to each other, and that the cooperation between co-workers is good, also between different work groups ... and the management. ... I think that this is what constitutes safe work practices”.

Two of the personnel safety representatives spoke about the increasing age of the workforce employed at their specific installation, and emphasized that the age of the employees was one of the most important challenges within the Norwegian petroleum industry. The age of the workforce on their respective installations was estimated to be approximately between fifty and sixty years. The high age of the workforce is a problem because it implies that a large part of the workforce will retire in a few years, and thereby the industry will lose important competence in the years to come.

